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[OFFICIAL NOTICE.]

Third Annual Meeting, American Gas Institute.

AMERICAN GAS INSTITUTE HEADQUARTERS,
25–29 WEST 39TH ST., NEW YORK CITY, Oct. 5, 1908.

GENERAL ANNOUNCEMENT.

The third annual meeting of the American Gas Institute will be held at New York, N. Y., October 21st, 22d and 23d, 1908. The meeting will be called to order by the President, Alex. C. Humphreys, of New York, at 10 A.M., Wednesday, October 21st.

Meeting Hall and Headquarters.—The business sessions will be held in the Auditorium of the United Engineering Societies' Building, 29 West 39th street, between Fifth and Sixth avenues. The Auditorium is on the third floor of the building, and on the eighth floor are located the permanent headquarters of the Institute. On the days of meeting the Secretary and Treasurer's office at headquarters will be open from 9 A.M. to 6 P.M. When the Institute is not in session the President and officers will make their headquarters at the Hotel Astor, Times Square (Broadway and 44th street).

Members are particularly urged to write for their rooms at once and, in doing so, a reply should be requested, for which a self-addressed, stamped envelope should be inclosed, as misunderstandings may thereby be averted. The securing of rooms well in advance is important, as the hotels are liable to be well filled at this time of the year.

Roll Call.—The roll call will be made by means of the door card system. Each member upon entering the hall for the first time will, at the door, receive a special card upon which he will find his name, address, etc., as these appear in the Secretary's books, and such card should be corrected and returned to those in charge. Members should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

The following list of hotels with rates is submitted:

Hotel.	Location.	Single Room.		Double Room.	
		Without Bath.	With Bath.	Without Bath.	With Bath.
Breslin	B'way, cor. 29th st....	$1.50	$2.50	$3.00	$4.00 up.
Gilsey.....	" " "	1.50	2.50	2.50	3.50 "
Imperial	" and 32d st	2.00	2.50	4.00	5.00 "
Martinique ...	" " 33d st.....	2.00	2.50	3.50	3.50 "
Herald Square.	" " 34th st....	1.50	2.00	2.50	3.00 "
Marlborough ..	" 36th and 37th st.	1.50	2.50	2.50	3.00 "
Knickerbocker.	" at 42d st.....	2.00	3.00	....	5.00 "
*Astor.....	Times Square.....	2.50	3.50	3.50	4.50 "
Manhattan.....	42d st. & Madison ave.	2.00	3.00	4.00	5.00 "
Belmont.....	" " " Park ave.	2.50	3.50	4.00	5.00 "
Grand Union..	" " " " ..	1.00	2.50	2.00	3.50 "
Holland.....	5th ave. and 30th st ...	2.00	3.50	3.00	4.50 "
Waldorf.....	" " " 34th st...	3.00	4.00	5.00	6.00 "
Savoy.....	" " 58th & 59th st..	2.50	3.00	3.50	4.50 "
Netherlands ..	" " and 59th st ..	2.00	3.00	....	5.00 "
Prince George	14 East 28th street....	....	2.00	....	3.00 "

* The banquet will be served at the Hotel Astor on Thursday evening, October 22d.

The above prices are all minimum rates for one person in a room, European plan. Rates for two persons in one room may be obtained by communicating with whichever hotel may be selected.

Badges.—All members attending the meeting are particularly requested to bring their membership badges, as the Committee of Arrangements is preparing an identification badge for each member which will require the regular membership badge for its proper completion.

LIST OF PAPERS AND REPORTS.

The papers and reports to be read at the meeting are as follows:

List of Papers.

"High Pressure Distribution;" by Mr. Jacob D. von Maur, St. Louis, Mo.

"Benzol Enrichment;" by Mr. E. H. Earnshaw, Newark, N. J.

"Some Further Remarks on the Photometry of Gas;" by Mr. Chas. O. Bond, Philadelphia.

"Physical Theory of Coal Carbonization;" by Mr. W. H. Fulweiler, Philadelphia.

"Vertical Retorts;" by Mr. J. H. Taussig, Philadelphia.

"Relative Merits of Wrought Iron and Steel Pipe;" by Mr. Frank N. Speller, Pittsburgh.

"Report of Progress on 'A' Meters;" by Mr. W. J. Serrill, Phila.

"Report of Progress on Dipping Meters;" by Mr. W. A. Castor, Philadelphia.

"Holder Cups and Tank Heating;" by Mr. C. J. Ramsburg, Phila.

"Better Gas Illumination;" by Mr. Thomas J. Litle, Gloucester, N. J.

General Reports.

Report of the Public Relations Committee; Mr. E. G. Cowdery, Chicago, Chairman.

Report of Technical Committee; Mr. W. H. Gartley, Philadelphia, Chairman.

Report of Board of Revision of the Question Box on the Manufacture of Gas; Mr. J. D. Shattuck, Chester, Chairman.

Wrinkles; Mr. M. R. Bump, Editor, New York.

Accidents; Details by Members.

Special Reports of the Sub-Committees of the Technical Committee.

Report of Committee on Calorimetry, Mr. R. B. Brown, Milwaukee, Chairman.

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Report of Committee on Uniform System of Accounting, Mr. R. A. Carter, New York, Chairman.

Report of Committee on Pipe Standards, Mr. A. S. Miller, Baltimore, Chairman.

Report of Committee on Electrolysis, Mr. A. G. Glasgow, London, Chairman.

Report of Committee on Unit of Light, Mr. W. H. Gartley, Philadelphia, Chairman.

Report of Bureau of Information, Mr. W. A. Baehr, St. Louis, Chairman.

Report of Proceedings of International Committee for Standardization of Threads for Gas Appliances, Mr. A. G. Glasgow, London, Delegate.

Announcement.—Sight-seeing Trip to Consolidated Gas Company's Plant, by Mr. W. C. Morris, New York.

Note.—In order that the Proceedings containing the report of this meeting may be published and issued to the members immediately after the meeting, notice is hereby given that if any of the speakers at this meeting desire to correct their remarks before they are printed, they will be given an opportunity before leaving New York. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meeting, and all those who desire to correct their remarks must notify the Secretary at the close of the session at which such remarks are made, as all reports will be turned in to the Publication Committee and thence to the printer immediately after the adjournment of the meeting.

Entertainment and Hours of Meeting.

Wednesday, October 21.—The business sessions will be from 10 A.M. to 12:30 P.M., and from 2 P.M. to 5 P.M. The evening will be at the disposal of the members, no entertainment having been arranged for Wednesday.

Thursday, October 22.—Business session from 10 A.M. to 2 P.M. Remainder of afternoon at the disposal of members. Tickets of admission will be given to those who desire to visit the gas and electric stations in and around the city. The banquet for members and guests will be held at the Hotel Astor at 6:30 or 7 P.M. This hotel is noted for its excellent service, and it is the desire and expectation of the Committee to make this a most attractive feature, both as regards the quality of the dinner and the speaking afterward. Arrangements have been made for the ladies to attend the performance at the Hippodrome on Thursday evening, this entertainment being both unusual and interesting, in fact, the only one of its kind.

Friday, October 23.—Business session from 10 A.M. to 12:30 P.M. After adjournment members are invited to inspect the plant of the Astoria Light, Heat and Power Company. Luncheon will be served on the steamer while making the trip from Manhattan to Astoria. The return trip will be made in time for members to dine at their respective hotels.

Luncheon for the ladies will be served at the Hotel Astor, followed by an automobile trip around New York, giving them an opportunity to see many points of interest. The automobiles will start from the Hotel Astor at 2 P.M. Friday evening will be at the disposal of the members.

Saturday, October 24.—The Committee has arranged an excursion up the Hudson to West Point for members, ladies and guests. Luncheon will be served on the special steamer "Sagamore," which has been chartered for the occasion. In addition to the other interesting features at West Point, there will be a dress parade of the cadets. Returning, the steamer will reach New York in time for dinner. The Committee will endeavor to so arrange that parties desiring to continue west on their homeward trip may do so from West Point by train either on the West Shore Railroad or on the New York Central Railroad.

Tickets for Entertainment.—$5 for ticket to banquet; $5 for ticket for excursion, which includes: A ticket to West Point and return, including luncheon for member with complimentary ticket for one lady guest. One ticket to Hippodrome; one ticket for automobile trip around New York; one ticket for ladies' luncheon, for use of member's lady guest only; $5 for extra guest ticket, which includes: one ticket to West Point and return, including luncheon; one ticket to Hippodrome; one ticket for automobile trip around New York; one ticket for ladies' luncheon (for the use of a lady guest only).

By invitation of the Consolidated Gas Company, transportation to Astoria, including luncheon, will be furnished to members only, on application to the Treasurer of the Committee on Arrangements, Mr. W. Cullen Morris.

Separate extra tickets for the Hippodrome can be obtained only from the Chairman of the Reception Committee, Mr. C. H. Dickey. Separate extra tickets for the automobile trip around New York can be obtained only from the Chairman of the Reception Committee, Mr. C. H. Dickey. Complimentary tickets of admission to the gas and electric stations in and around the city will be furnished to members on application to the Treasurer of the Committee on Arrangements, Mr. W. Cullen Morris. These tickets, when presented at the various stations, *must* be accompanied by the regular Membership Badge for the purpose of identification.

Special Notes.

Please fill out the inclosed stamped and addressed postal card and mail *at once*. This will materially aid the Committee of Arrangements and prompt replies will be much appreciated.

Be sure to obtain a railroad certificate when buying your ticket to New York. The greater the number of certificates handed in, the easier it is to obtain the reduction in rates for future meetings, since the railroad officials count the certificates turned in as marking the full attendance. Apply for ticket and certificate at least 30 minutes before train time. Each person must sign his own certificate at time of purchasing tickets to New York. Members will please hand the Assistant Secretary their certificates, accompanied by 25 cents for each one, upon arrival at Headquarters. If there are 100 members present holding certificates, each certificate will then be promptly indorsed and held at the Institute Headquarters where members should call for them. Apply for return tickets at least 30 minutes before train time and have your certificates with you. All persons, ladies included, attending the meeting are entitled to the reduced rate from the territories named. Keep this circular in your pocket and apply to it if in doubt. Alex. C. Humphreys, President.

[Special Editorial Correspondence.]

THE SECOND ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY.

If there had been any question in the past as to the position of the Illuminating Engineering Society as a permanent organization, that question was answered decisively in the affirmative last week. The convention held at the Hotel Walton, Philadelphia, Pa., on the 5th and 6th insts., was a success in every sense of the word. The papers were among the most valuable so far presented to the Society, and the attendance was a record maker, for a total of 400 assisted in the proceedings. Right here it may be said that the Philadelphia Section deserves great credit for the arrangements, not only for the meeting but for the sensible and enjoyable entertainment that was unsparingly provided. Again, as an aid to the occasion, the weather was perfect. The sessions were called to order the morning of the 6th, by Mr. George Green, Chairman of the Convention Committee, who introduced Mayor Reyburn's Secretary, Mr. Gleason, as the man who was to bid all "Welcome to our city," and he acquitted himself well; yes, royally. Thereupon the President, Dr. Louis Bell, of Boston, delivered his presidential message, the main topic of which had to do with street lighting. The Doctor spent the past summer abroad, and he was very forcibly impressed by the superiority of street lighting there as compared with that done in this country, especially as regards the meager amount of illumination which we in the States consider sufficient; perhaps the word adequate would better express our relation to the matter.

The next regular technic before the meeting was the "Report of the Committee on Nomenclature and Standards," which, in the absence of Dr. A. C. Humphreys, was presented by Dr. Hyde. The report, which covers a proposed change in the value of our standard candle, is justly the first important movement with which the Society has been identified, and, as is well known, it has already been indorsed by The American Institute of Electrical Engineers and will also come before The American Gas Institute at their annual convention in New York next week. There was no discussion of either of the reports prior to the morning adjournment. While the session was on the visiting ladies were being entertained by those of the Philadelphia section, after which a most enjoyable luncheon was served for all in the Ball Room of the Walton; had there been speeches it would have been termed a banquet, as it was Old Home Week. The afternoon was given over to festivities, seats in the various grand stands being provided for all who wished to view one of the largest military parades held in this part of the country for some time. Those who did not care to witness the parade did not find that time was hanging heavily on their hands as there was a most important, as well as interesting, exhibit adjacent to the meeting hall of lighting appliances. One of the most attractive features of the exhibit was the absence of any commercial element. The largest exhibit was by the Welsbach Company, whose display included not only the very latest lamps of to-day, but also carried an historical collection of burners, with specimens dating back to the very inception of Dr. Auer's wonderful discovery. The display by the Humphrey Company, of Kalamazoo, was in every sense an attractive one, and some of the tungsten devotees had to admit that the original gas arc had lost none of its potency. The exhibit by the Ramsdell Company was well put together, and those in charge of it were well up to the work of "keeping on the job." The exhibit by the United Gas Improvement Company was a well arranged display of apparatus concerning the illuminating engineer, and included a bar photometer, set and ready for action, a candle balance and several secondary standards. Similar exhibits were made by the Electrical Testing Laboratories concern.

The Philadelphia Electric Company had a very beautiful and complete display of electric lamps with various accessories. They also fitted up a compartment booth equipped with various types of lamps, both gas and electric, with a number of colored silks in each. One of the compartments was illuminated by means of daylight, and the result, as might have been expected, mainly emphasized how far from daylight are any of the artificial illuminants, so as far as bringing out color value is concerned.

The same matter was brought up in a paper, which will be referred to later, which noted that from tests made with a new instrument termed the colorimeter it was found that the Welsbach lamp approached daylight more nearly than any other of the small units; for instance, such as our latest arrival, the tungsten.

The evening session was started in the presence of a large audience. All of the seats were filled, and the occupants were seemingly more content because of the fact that the entertainment card for the ladies announced that euchre would be their game rather than bridge.

The first paper was presented by Mr. T. J. Litle, Jr., and his confreres were much in evidence, seeing that Messrs. Gartley, Bond, Forstall, Norris, Klump, Hare, Roylston, Richman, Wardell and Sneider were on hand, and that amongst the prominent visitors were Dr. Elliott, and Messrs. P. J. Conroy and J. J. Humphreys, Jr., all of New York, along with Messrs. Gifford and Ware, of Boston.

Mr. Litle recounted some of the successful methods of ignition and control which have been used by his Company, and was rewarded by quite a full discussion from Messrs. Sharp, Morton, Lansingh, Campbell, Forstall, Beck, Gifford and C. Willing Hare—the latter is quite speedy in speech. This paper was followed by one which is virtually fitted to stand as a text book on the subject for a long time. The subject was the "Illuminating Value of Petroleum Oil," and the author was Dr. Arthur H. Elliott. The discussion naturally turned to the subject of the Doctor's well-known secondary standard. The discussion, which was entered into by Drs. Bell and Hyde, and Messrs. Gifford, Bond, Ware and E. L. Elliott, brought forward the importance of a reliable secondary standard, which was of similar character to the flames such as the gas to be measured. It might be mentioned in passing that the authors were only allowed 5 minutes to abstract their papers, and as the members had received copies in advance, this method was proved to have the merit which leads to success. The next paper, on "Street Lighting: Fixtures and Illuminants," by Mr. H. Thurston Owens, was illustrated by lantern slides. The readers of the JOURNAL may be interested to know that Mr. Owens selected for his preface a remark made by Mr. Norton H. Humphrys, included in his English correspondence in our issue for Oct. 1, 1894. The paper was mainly a plea for better fixtures and better light distribution, the slides showing types of street lamps in use in this country and in Europe. It was discussed by Dr. Bell and Messrs. Bond, Lansingh, Litle, McCreery, Woodwell and C. Willing Hare. The next paper was a plea for more outlets, so that the Society's members cannot be called conservative. It was by Mr. James R. Strong and was entitled "Structural Difficulty in Installation Work." Through the discussion he was enabled to hear about the troubles of Messrs. Coleman, Jones, Calvert, Forstall, McGuire and C. Willing Hare, but he could hardly feel encouraged from the recital.

Of the 18 papers presented all were read by the authors with the exception of two, and there was only one change in the order of presentation as prearranged. The final paper presented at this session was a report of some tests at the Bureau of Standards on incandescent lamps, by Mr. F. E. Cady, and the discussion by Doctors Sharp, McAllister and Hyde, and Messrs. Millar and Haskell brought to light the fact that further tests were in progress, from which it was expected certain formulas could then be deduced.

Even though the members of the Council were up late at a meeting, and several other members were up at other less serious meetings, they all came to the morning session ready for business. And the ladies! Well, they just rode around Fairmount Park in automobiles, and did other enjoyable travellings under the guidance of their guests. However, returning to business, Mr. Leonard J. Lewinson presented a paper upon "The Intensity of Natural Illumination," the data whereof will prove very valuable, especially in connection with others which have been read upon kindred subjects. The discussion was opened by Mr. Hering, who was followed by Messrs. Woodwell, Perot, Lansingh, Gibbs and Bond. "The Advantages of the Integrating Sphere in Photometry," were well set forth in a paper by Messrs. Sharp and Miller, which was discussed by Messrs. Cady, Owens, Wohlauer. The succeeding paper brought clouds into the bright blue sky, for the author trod upon the toes of one of the daylight exponents among our electrical friends. Dr. Herbert E. Ives presented a description of the Ives colorimeter, which is designed to measure the color values of light sources. The wide discrepancy between daylight and our artificial illuminants were verified and the value of the instrument as a means of ascertaining the factor of color blindness was demonstrated. The members entering into the discussion seemed to thoroughly appreciate the value of the instrument. They included Doctors. Hyde and Bell and Messrs. Moore, Woodwell, Perot and E. L. Elliott.

The morning session was concluded by a paper by Mr. Carl Hering, covering the "Calculation of the Values of Light Sources." The author brought out a number of new factors into the already little understood nomenclature, and on this score the principal objection was made by Messrs. Wohlauer, Moore and Elliott and Doctors Bell, Sharp and Hyde.

The convention adjourned at 12:30 P.M. so that a photograph could be taken, and reconvened promptly at 2 P.M. There were no less than seven papers for the afternoon session, and the President deserves great credit for the manner in which the work was carried along. It was opened by Mr. V. R. Lansingh with a paper upon the "Calculation of Illumination by the Flux of Light Method." Similar problems were brought forward by papers presented by Messrs. L. B. Marks, Alfred A. Wohlauer and T. W. Rolph, and the discussion of these various papers was very interesting, those sharing in the debate being Drs. Bell and McAllister and Messrs. Codman, Millar, Gifford, Bond, Marshall, McGuire, Hopton and Elliott.

A very important paper was read by Mr. J. C. Woodwell, upon the subject of "Intrinsic Brilliancy," and also one upon "Architecture and Illumination," by Mr. E. G. Perot. The paper by Mr. E. N. Wrightington on "Street Lighting with Gas in Europe," was read by Mr. R. C. Ware, and several interesting details were brought forward.

The convention adjourned at 5:30 P.M., but many remained for the vaudeville entertainment held in the evening.—CORRESPONDENT.

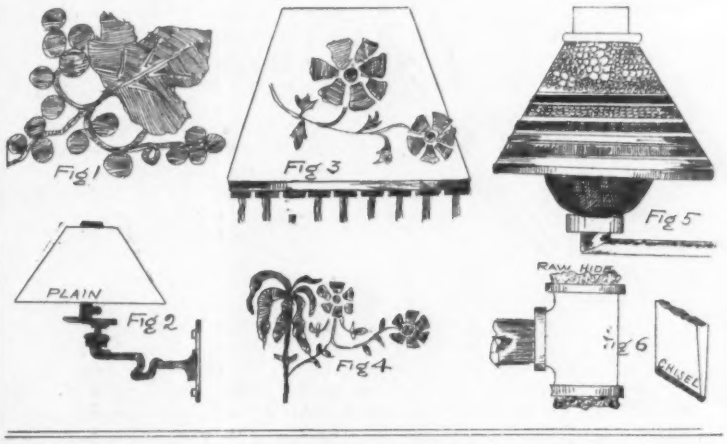
Modern Light Shades.

[Communicated by "R."

As a natural sequence of the almost universal introduction of improved forms of gas arcs and lights of similar type, numerous elaborately designed light shades have appeared. Shades constructed of sheet metal, mica, transparent patented compositions, cardboard, leather, paper pulp, glass, agate, etc., are well established in the gas lighting world at the present time, and on visiting some of the places where these shades are designed and manufactured you will be surprised when you observe the order and system acquired as a result of years of practice. The sheet metal shades are made particularly attractive. The process involves the placing of flat pieces of common tin or brass on a pattern block, on which dies are used for defining the figure. Perhaps the design requires a process of embossing, in which case compressing dies are used and the engraving is stamped thereupon. The raised letters, figures, scrolls, angles, flowers and the like result in an effective design when set off by various hues of light.

Then there are designs which are cut out of the thin sheet metal by means of tin shears. The design is marked off on the surface of the metal and the artisan follows around the lines. In the event of interior work being needed, chipping or other pointed instruments are called into play. Some very fine work is done on the metal shades. Fig. 1 is a drawing of some general effects produced on the metal shade stock. Representations of leaves and grapes always take well.

The demand for shades for setting forth strange hues of light has increased wonderfully in the past few years. The hostess desires that, when guests enter the hallway, a dull, odd-colored tint be spread over the surroundings. These hues are calculated with such



nicety that the furniture and trimmings can be matched and set off to advantage. In some houses there are vari-colored glasses used so as to revolve the hues. In one large hall I noticed, upon entering, that a deep green hue was cast over the rich surroundings, setting them off to wonderful advantage. The drooping foliage imitation looked very real. Then, as by clockwork, the hue altered to a maroon and the effect was very striking. It was accomplished by a system of tinted glass shades used on a number of revolving lights. A notched cam was employed in a mechanical contrivance which was manipulated by a little water motor beneath the space of the stairway. A belt extended from the driving wheel of the motor to a shaft running along with the line of the suspended lights. At each depresion in the cam the shaft was made to take a quarter turn. Four different hues were obtained by the four different movements, as the shades were divided off into four colors, each color being presented alternately. It results in a pretty effect to apply this idea to studios, libraries, smoking rooms, exterior porches and arches, etc. Fig. 2 shows a plain shade in readiness for the handiwork of the artisan. Persons who desire to have certain figures or designs put on the shades visit the studios where such work is done and, at a certain fixed rate, are able to procure the necessary fashionable design work.

The fad has developed to a point where it is profitable for men and women to devote all their time and energy to the painting or otherwise patterning of designs for shades for lights. Simple figures are often called for, one of which is shown in Fig. 3. On the other hand

there are persons who demand the most intricate of patterns on their lamp shades. Some want to have a deluge of presentations in flashy tints, while others desire the simplest of forms. The artist has to cater to the requirements of the various tastes, and this is no small undertaking. As there is money in the business, however, quite a number of skilled people are earning good profits for their time in this way. In some of the shops they first make a pattern of stiff cardboard of a certain design, as in Fig. 4. Then with this model it is possible to outline a number of kindred figures on any surface. The outlining furnishes the pattern for filling in. This simplifies the work; but as many patrons do not want a design which has been used elsewhere, an entirely new figure is preferred. The difference in the multiple and the single pattern is that the former can be made up cheaply and quickly. While the exclusive sort require time, they also cost more. Fig. 5 shows a form of shade treated to suit the needs of a certain patron. The stripes are all in colors.

In chipping out a pattern from metal or cardboard, the rawhide head-mallet can be used to advantage, shown in Fig. 6. You need a number of chisels, a point of one of which is also shown in Fig. 6. Different widths of edges should be kept in stock, well sharpened and in readiness for use.

Address of the President (Mr. D. H. Frazer) of the Michigan Gas Association, Seventeenth Annual Meeting, Kalamazoo, Mich., Sept. 23-25.

Gentlemen of the Michigan Gas Association: We are assembled, in this 17th annual convention, in a city which is making magnificent strides in a gas and residual as well as in a municipal sense. We should obtain ideas here, outside of our proceedings, sufficient alone to warrant our attendance.

It is my sad duty to announce the death, during the past year, of Mr. Sedgwick Dean, of Ann Arbor. Mr. Dean was for many years a member of this Association, and until recently an active worker in its interests. Suitable resolutions will be prepared by a committee.

The past has been a panic year. Immediately after our last meeting there began a period of depression which continues, in spite of the many optimistic predictions at the time, and which has been the cause of the adoption of a policy of retrenchment in our business which has not been altogether a bad thing. We were going a pretty good gait, and the jar brought us to a state of self-inquisition, reflection and contemplation. We found stocks of materials and supplies could be reduced and old stocks cleaned out, inferior employees were weeded out, more attention was paid to collections and the terms of appliance sales, and we are in better shape to continue thereby. The price of cast iron pipe has been considerably lower than in several years, advantage of which has been taken to make some needed reinforcements in distributing systems. Notwithstanding the depression, the sales of gas have been less affected than most manufactured products; in fact, many companies have so far a nice increase over last year, especially in those cities where attention is being given to the introduction of gas for industrial purposes.

In this connection I wish to direct your attention to the wonderful possibilities of sales of gas for industrial and mechanical heating, efforts to obtain which have been limited to a comparatively few companies. The industrial departments of some companies are equaling in importance and results the commercial or new business end. It has been repeatedly said of certain cities that the field was very limited. Owing to the magnitude and nature of this class of business, certain conditions must be met, and it is rather, I think, because of the non-recognition of these conditions, and the lack of an extended campaign by a competent industrial gas expert, that the possibilities in these communities seem limited.

The competition in commercial lighting has been very keen, due largely to the more general introduction of high efficiency, metallic filament, electric lamps, and, in some places, to gasoline plants. In a paper read before the Wales and Monmouthshire Institution of Gas Engineers, Mr. J. H. Canning makes a statement, in comparing gas at 75 cents per 1,000, and electricity at 7 cents per kw., and including renewals, as follows: "For equal amounts of light, incandescent gas is only ¼ the cost of the most efficient of the metallic filament lamps." Reports of tests in this country also lead us to believe that the introduction of the improved electric lamps will not seriously affect us. Our gas burner manufacturing friends are not asleep, and the present outlook is that this fall we will be in a stronger position to meet competition than ever.

Now that push-button gas lighting is working successfully, there is need of a satisfactory porch lamp to operate by a push-button, not so much for the consumption by the light itself as for the business obtainable by having such a light. In a great many cities the majority of houses are either piped or wired, not both, and frequently electricity is chosen on account of the porch lighting where otherwise gas would be preferred. The advent of inverted mantle lighting further accentuates the importance of uniform pressure, the maintenance of which is yearly becoming more difficult, due to increasing output.

I recommend for your careful consideration the papers to be read at this meeting on distribution, and if, following the discussion of this question, this Association cannot go on record as to the best means of amplifying present distribution systems, I suggest the advisability of the appointment of a committee to study the problem.

We should adopt a policy of publicity of our affairs. The majority of people believe in fair play, and the feeling against gas companies is due largely to misapprehension of the facts. Many companies are "talking" to the public through the press, a publicity of facts and conditions, not ordinary advertising. For example, the talks by the Wisconsin Telephone Company and the United Railways Company, of Baltimore. Who knows but what the rather unusual proceedings in Frederick, Md., and Calumet, Mich., when the contentions of the gas company were supported by a majority of the customers, were due to a past policy of frankness on the part of the company. In the former case a bill had been introduced proposing to reduce the rates, and in the latter the Company petitioned to be allowed to increase the rates.

I believe the one thing of all others which tends to promote an agitation for cheaper gas is inferior quality of gas and poor service. People are willing to pay for service, and I strongly recommend the purchase by every company of a calorimeter, and the making of daily tests of the heating value of its gas, to the end that same be absolutely uniform in quality. Probably no better policy in this respect could be pursued than to obtain a copy of "Pamphlet U-21," issued by the Wisconsin Commission on regulations covering service, and to live up to the regulations therein.

This fall there will be submitted to the people a proposed new constitution for the State of Michigan in which the whole spirit and purpose of the provisions affecting our industry, seem to be to put the various public utilities (except railway and express companies) entirely in the control of the several municipalities within which they do business, leaving such business to continue to be the subject of negotiation and agreement between the companies and the municipality, without any prospect of having a general supervision of the business on uniform terms applicable to all the companies in the State, by a State commission. Under the proposed constitution the municipality will have a clear right to own and operate such utilities with the power to obtain credit for that purpose, in excess of the general limitations, by giving a lien on the works, the mortgage securing to the bondholders, in case of foreclosure, a 20-year franchise to operate under.

The signs of the times indicate that capital invested in public utility companies is to receive a consideration and protection in the future that it never had in the past. The questions of plant valuations and costs of gas are being threshed out before the courts and utility commissions. In these matters more progress has been made towards enlightenment, both to ourselves and the public, the past year than ever before. There are now State commissions regulating gas and electric companies, I believe, in four States. The members thereof are endeavoring to be fair. A member of the latest one, the Wisconsin, has stated, they wish us to earn a reasonable return on our capital. The members of these commissions, as well as we, are learning that the difference between receipts and present disbursements is not profit. We have all learned, and only recently regrettably, that mains and holders, and sometimes even whole plants, must be replaced. Now and then we have a fire or a damage suit. We have learned that, as we are called upon to meet these bills, the fund we should have laid aside to do so has gone to reduce the price of gas in order that we might be permitted to exist, to continue our business in peace. We have learned that, in addition to the costs of gas as computed in the past, there are the costs necessary to produce a fund to cover depreciation, and arriving thus far we have learned the word depreciation is not big enough. This fund has also been called a reconstruction reserve fund. It occurs to me it might properly be called a replacement and contingency reserve, and those of you who have not already done so should add to your present costs sufficient to create a fund to cover the costs occasioned by replacements which will surely be necessary by reason of obsolesence, inadequacy, decay and public requirement, and contingencies due to hazards of the business, casualties, fire, legal expenses, damage suits, electrolysis, etc.

The price of gas fixed by utility commissions will be based upon costs, and in arriving at costs these things will be considered. We, as well as the public, have been in comparative ignorance concerning

these matters. Now, in view of the investigation and hearings throughout the country, the question will be better understood, and with an understanding of the facts you can trust in the American people for fair play.

We should anticipate and be prepared to meet increasing costs. This is an age of combination, and the indications are yearly more and more of community of coal interests and centralization of coal land control, which, together with the railway companies' proclamation of freight rate increase, emphasizes the need of caution in any readjustment of prices for gas. The lower we can make the price of gas the better will we be able to meet competition and the greater will be the possibilities of increasing gas sales, but in view of the fact that we are learning what replacement and contingency reserve costs are, and until the question is settled authoritatively, neither we, nor any municipality, are in a position to correctly and fairly set a price.

An analysis of the last census of manufactures, issued by the Department of Commerce and Labor of the United States Government, shows, from statistics gathered by it, that for the last year the census was taken (1905) the combined gas companies of the United States did not earn 6 per cent. net on their actual capital invested—I say actual capital invested, not capitalization, advisedly.

Some companies, in view of their careful management, ability of officers and close attention to operating economies and good service, do better than the average and they should be entitled to fair returns, otherwise what incentive would there be for efficiently managed plants and excellent service? I trust it will not be long before it will be possible for any municipality to satisfy itself as to and arrive at the correct costs of gas. The real costs will show that our returns are insufficient rather than excessive, and that they are less per unit of investment than any other staple product of manufacture as shown by United States Census Bureau statistics.

It is unfortunate that the ability to obtain funds to make extensions and keep pace with the growth of this country is dependent upon a contracted price for our product to cover a long term of years. We cannot read the future and the procedure is unbusinesslike. No other manufacturer is compelled to, nor would he dream of setting a price for his product for a term of 20 years. This is a transformative period in our business, and it behooves us to go slow in assumption of contractual obligations.

In the meantime, let us make the best quality of gas we know how, watch closely all those details which go to make perfect service and adopt such a policy of publicity as will acquaint our customers with the real facts and conditions existent in our business; make them our friends and endeavor to reach that state of understanding whereby we may safely let them be our final arbiter.

Gentlemen, I thank you.

Destructive Distillation of Coal at Low Temperatures.

[Prepared for the Michigan Gas Association, Seventeenth Annual Convention, Kalamazoo, Mich., by PROF. ALFRED H. WHITE and MESSRS. FRED. E. PARK and WM. A. DUNKLEY, Kalamazoo, Mich., September 23–25.]

When coal is charged into a gas retort, although the hot walls of the retort may quickly raise the outer layers of coal to a red heat, it is certain that the inner portions of the charge will be heated slowly—not only because the transfer of heat through the porous coke is slow, but because the heat absorbed in the decomposition of the coal also checks a rise of temperature. The almost steady yield of gas during the first two-thirds of the distillation period indicates that the temperature of the center of the charge has not reached its best working temperature until after the middle of the run, or roughly, until after 2 hours. The progressive change in the composition of the gas in the latter portion of the heat is to be laid largely to secondary reactions caused by the filtration of the gas from the cooler center through the hotter coke on the outside of the charge. If the assumption be correct that some considerable change in the composition of the coal in the retort takes place at a temperature well below a red heat, a knowledge of the products of these primary reactions at low temperature should aid in our study of the more complicated process of commercial gas manufacture.

A study of this sort might also throw some light on the problem of the differences between the coking bituminous and the non-coking bituminous coals. Our coals are derived from the decomposition of vegetable matter. It is believed that this vegetable matter accumulating under water in swamps underwent a marked preliminary change through the agency of bacteria, the resulting peaty product being poorer in oxygen and hydrogen and richer in carbon than the original vegetable tissue. Possibly the question as to whether the future coal was to be coking or non-coking was decided at this early stage, by the differences in nature and extent of bacterial action and the extent to which the myriads of jellylike bacteria contributed their bodies to swell the mass of growing coal. In any case, however, a dense coal could only be obtained from this mass if it became covered with thick layers of earthy matter which by their weight solidified the mass. The more powerful earth thrusts as the land rose or fell must have caused greater pressures with resultant rise of temperature, bringing about a slow destructive distillation of the coal, gases relatively rich in oxygen being evolved and the resultant coal remaining richer in carbon and poorer in hydrogen and oxygen. The coals which are geologically older and have been longer exposed to this metamorphic action are usually, as might be expected, lower in volatile matter. Thus the coking coals of Pennsylvania are intermediate in their age between the anthracites and the poor coking coals of Michigan and Illinois.

Ste. Claire Deville, the eminent French chemist who has been for more than a generation Consulting Chemist of the Paris Gas Company, has, as a result of nearly 2,000 tests, conducted at the experimental works of the Company, divided coals into groups according to the relations of their percentages of oxygen to hydrogen, and holds that all coking coals contain a percentage of oxygen approximately twice that of the hydrogen. Ste. Claire Deville's generalization has been quite widely accepted and in general holds true for the coals of this country. The good coking coals have about twice as much oxygen as hydrogen, the semi-bituminous steam coals have relatively less oxygen, and the weak coking coals of Michigan and Illinois have more oxygen than the coking coals.

If the change from decomposed vegetable tissue, through the various grades of bituminous coal to anthracite, has been caused mainly by pressure and the long-continued application of gentle heat without access of air, the difference between the coals from Illinois and Pennsylvania being merely that the change in those from Pennsylvania is more complete, it would seem that possibly the artificial application of heat which gives as its first product water and other compounds rich in oxygen would lower the relatively high oxygen of the non-coking coals and possibly bring them into the coking class.

These two lines of reasoning prompted the laboratory experiments which are partially presented in this paper. At the time when they were started 3 years ago, the field was practically untouched. Within the last 2 years, however, several investigators have been working along somewhat similar lines. The much discussed coalite is a bituminous coal changed by just such a slow heating to a maximum temperature of 800° F. (425° C.), and the interest aroused by coalite may cause these experiments to be followed with more interest than they otherwise would be. E. Börnstein[1] has published the results of tests on eight German coals with results in general similar to those reported here, while in this country Prof. Parr, Dr. Porter and Mr. Ovitz, of the United States Geological Survey, have been working in at least related fields, although their work has not yet been published, and the results are known to us only in barest outline. Apparently we have all been attacking the problem from different viewpoints and our experiences overlap but slightly.

Experimental Method.—Our low temperature distillations were carried on in the following manner: A sample of from 50 to 70 grammes of dried coal, ground to pass a 12-mesh sieve, was placed in a hard glass tube closed at one end. This was slipped into a heavy metal jacket intended to promote uniformity of temperature and placed in a combustion furnace. At the front end of the tube was a pressure gauge followed by an absorption train to remove water and CO_2, and a graduated gasholder. Before starting a distillation the greater part of the air in the train was pumped out, so that it should not react with the heated coal or gases. The liquid products of distillation were collected and measured, but their small amount precluded any quantitative examination of them. The change in the properties of the coal after heating were noted, also the amount and composition of the gases evolved. This examination of the gases caused considerable difficulty on account of the simultaneous presence of hydrogen, methane and ethane. The method of Jaeger for fractional combustion of the hydrogen and hydrocarbons by copper oxide failed to give satisfaction with these gases, as it was found almost impossible to get complete combustion, there being always a

1. *Journal fur Gasbeleuchtung*, Vol. 49, p. 627-667.

large residue of apparent nitrogen. Experiments with synthetic ethane showed that the difficulty apparently lay in the combustion of that gas. Satisfactory results were finally obtained by using Campbell's method for the removal of hydrogen by a hot solution of palladium chloride, followed by Dennis and Hopkins method for the combustion of the hydrocarbons. The following five widely different varieties of coal were tested:

Name.	Nature.
1. Zeigler, Ills	Non-coking.
2. Cambridge, O	Semi-coking.
3. Cannel	Feebly coking.
4. Pittsburgh gas coal	Coking.
5. Bay City, Mich	Coking.

Tests on Zeigler Coal.—The coal was furnished us by the U. S. Geological Survey as being the only Illinois coal which they had been utterly unable to coke at their coal testing plant at St. Louis, and as being one which had a ratio of oxygen to hydrogen higher than the 2 to 1 ratio usually presented in coking coals. The average composition of a carload sample was given by the Survey as follows:

Proximate Analysis.	Per Cent.
Volatile combustible	29.86
Moisture	10.72
Fixed carbon	50.06
Ash	9.36

Ultimate Analysis.	Per Cent.
Ash	9.36
Sulphur	0.91
Hydrogen	5.30
Carbon	66.74
Nitrogen	1.40
Oxygen	16.29

The coal contained, therefore, more than three times as much oxygen as hydrogen and seemed a desirable one to test. The experiments are described in the order of the test temperatures.

100° *C.*—To try the effect of long heating at a relatively low temperature a sample of Zeigler coal, hermetically sealed in a glass tube, was heated in a steam oven for over a year. At the end of the period it was opened carefully under mercury to collect the gas. Contrary to expectation, however, instead of gas rushing out, the mercury was sucked into the tube. There had certainly been no gas evolution due to destructive distillation. The diminution in volume was probably caused by absorption of the oxygen from the air of the vessel, the coal gaining in weight. Direct tests made by heating this coal in air at a somewhat higher temperature, 135–140° C., for 4 hours, showed a gain in the weight of the coal of 1.8 per cent.[2] Further heating for 4 hours, to 200–220° C., caused a further gain of .8 per cent. Further heating in presence of air for 6 hours at 250–270°, however, caused a diminution in weight of 7.5 per cent., showing that marked decomposition had commenced at those temperatures.

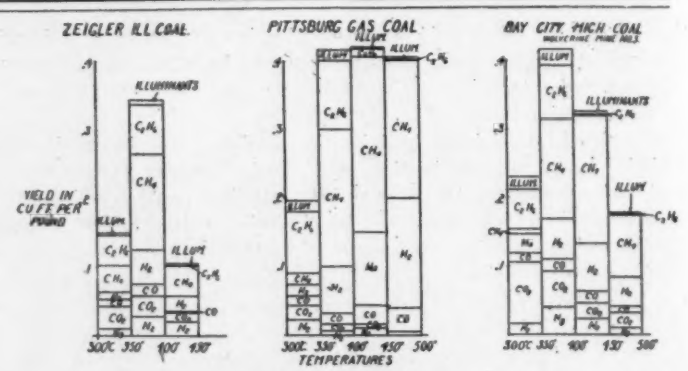
200° *C.*–300° *C.*—The distillations conducted at 200°, 250° and 300° showed such marked similarity in results that they may be treated together. Each distillation lasted from 1½ to 3 hours, and the chief product was an acid, watery liquid, containing some oily tar at the higher temperature. The amount of this watery fraction, as the mean of 3 sets of experiments, was 2.5 per cent. for 200°, 1.3 per cent. for 250°, and 1.5 per cent. for 300°. The change in the composition of the coal will be treated separately.

300°–450° *C.*—The temperature interval 300°–350° is a critical one. Soon after 300° a more rapid evolution of gas commences and continues at an increasing rate. The amount of liquid products reaches a maximum in this fraction. Above 350° it falls off. The yield of gas reaches its maximum in the succeeding 300–400° fraction and drops markedly in the 400–450° fraction. The variations in the yield and the composition of the gas for this interval are shown graphically in Plates 1 and 2 and will be discussed in connection with the other coals. The liquid distillates formed 16 per cent. of the weight of the coal. The change in composition of this coal is shown below:

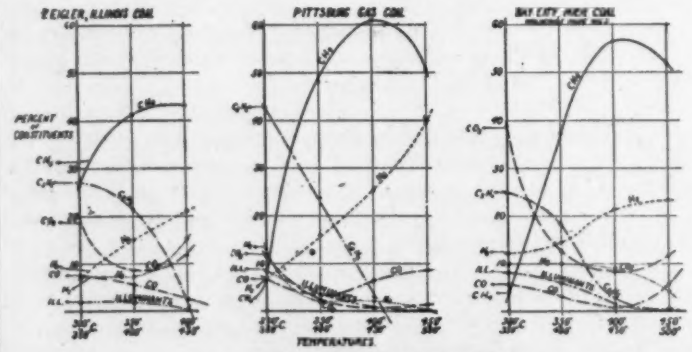
	Volatile C.	Fixed C.	Ash.
Heated to 200° C	36.8	54.8	8.3
Heated to 450° C	30.6	59.1	10.3

The proximate analysis of the untreated coal showed a very feeble coke, crumbling under the slightest pressure. At each interval of 50° the tube was opened, the coal examined and a small quantity removed for test of coking properties. Throughout the heating the coal changed little in appearance, with no tendency of the fragments to fuse together. Through calculations from the composition of the products of distillation it appears that the oxygen-hydrogen ratio reached the presumably desirable 2 to 1 ratio between the temperatures of 300° and 350°, but neither the coal withdrawn from the tube at those temperatures nor at any other showed any more tendency to coke than the original coal. On the contrary, the feeble coking property which the coal originally possessed disappeared as the heating progressed.

2. A private communication from Prof. Parr states that he has found that all coals commence an active oxidation when heated in air to 120° C.



YIELD OF GASES
DISTILLED FROM COALS AT LOW TEMPERATURES.
PLATE I.



ANALYSES OF GASES
DISTILLED FROM COALS AT LOW TEMPERATURES. PLATE 2

Tests on Cambridge Coal.—Duplicate tests on Cambridge (O.) coal showed the products of decomposition to be very similar to the Illinois coal, although the liquid distillates formed only 7.7 per cent. of the weight of the coal. There was very little decomposition below 300° C. Between 300° and 350° there was again a larger evolution of gas and liquid which had not completely ceased even after 6 hours' heating, with a decreased yield between 350° and 400°. Samples of coal were taken from the tube at the close of each heating and tested for volatile matter and coking properties with the following results:

Temp. of Heating.	Per Ct. Volatile.	Character of Coke.
200°	40.8	Not very good.
250°	39.4	Not very good.
300°	32.9	Very weak.
350°	24.6	Crumbles when touched.
400°	19.1	Non-coherent dust.

The grains of coal did not frit together during the heating, but remained separate from each other, as when introduced into the tube. The coking properties of the unheated coal when heated to a red heat were none too good, but the heating caused the coking properties to deteriorate and finally to disappear altogether.

Tests on Cannel Coal.—This coal behaved as did the other two. The decomposition below 300° was very slight and yielded almost exclusively watery products with a little tar. The heating at 300° was purposely prolonged more than 15 hours, with the result that over 6 per cent. of liquid products was collected, but less than .2 per cent. by weight of gases, thus confirming the previous observation that the critical temperature for gas evolution lies somewhat above 300°.

The coal as received gave a weak coke. The particles did not cohere on heating up to 400° in our combustion tube, and the coal which had been thus treated had completely lost its coking powers and gave only a fine, dry dust on heating to redness. The proximate composition of the coal follows:

	Volatile C.	Fixed C.	Ash.
Dried at 100°	45.7	41.1	13.2
After heating at 400°	22.0	57.0	21.0

Tests on Pittsburgh Gas Coal.—This coal gave even smaller amounts of distillation products than the others at the lower temperatures. The liquid products after heating for 1½ hours at 200°, 1½ hours at 250° and 2 hours at 300°, were only .3 per cent. of the weight of the coal while the gaseous products were negligible. The amount

and the composition of the gases evolved above 300° are shown graphically in Plates 1 and 2, and will be discussed later.

The appearance of the coal, when removed from the tube after heating to 450° C., was very different from that of the coals previously mentioned. They had come out of the combustion tube in loose grains as they had been put in. This coking coal swelled and fused together in the tube, producing a firm and shiny coke, which was 72 per cent. of the weight of the original coal, and which came out in smooth cylinders. The change in composition of this coal on heating is shown below:

	Volatile C	Fixed C.	Ash.
Dried at 100° C.....	36.7	58.5	4.8
Heated to 450° C.....	10.0	83.0	7.0

When one of these cylinders of coal which had been heated to 450° was placed in a crucible and heated to redness, it retained its shape and yielded a good coke. If, however, it was powdered and then heated to redness it remained as dust in the crucible. As, with the other coals, the fusible coking element had been destroyed by heating to 450° C., it follows that, in the commercial manufacture of coke, although the oven may be at a bright red heat, the coal fuses together and the coke structure forms below a red heat.

Tests on Bay City Coal.—This coal, originally a fairly good coking coal, behaved much like the Pittsburgh gas coal. Scarcely any gaseous products were evolved below 300° C. and the amount of liquid was 30 per cent. of the weight of the coal, two-thirds being tar.

The composition and amount of gaseous products evolved above 300° are shown in Plates 1 and 2 and discussed later. Like the Pittsburgh coal, the coarsely ground material which was charged into the tube swelled and fritted together in the heating, so that it was removed as a strong coherent cylinder which retained its shape and strength on coking, but refused to coke if ground again to powder before heating to redness. The weight of the charge withdrawn from the tube was 64 per cent. of that charged, and the change in composition is given below:

	Dried at 100°.	Heated to 540°.
Volatile matter.....	49.5	19.0
Fixed carbon.....	46.1	73.0
Ash.....	5.2	8.0
Sulphur.....	3.6	2.7
Heating value B.T.U.....11,030		14,200

Composition of Gases Evolved.—As stated in the paragraphs describing the behavior of the individual coals, the amount of gas evolved below 300° is negligible. Plates 1 and 2 show graphically the amount of each constituent of the gases for the Zeigler, Pittsburgh and Bay City coals, calculated in tenths of cubic feet of gas per pound of coal. It may be unwise to transfer our figures from the small laboratory experiments to these large scale units, but it is much easier to comprehend these units, and the secondary reactions are so much less important at these lower temperatures that the error is not as great as it would have been had we been working at the usual temperature of the gas retort. The three coals yield gas very similar in composition.

The unusual constituent in this gas is ethane, C_2H_6, which is totally absent from coal gas, though it sometimes occurs in natural gas. As seen clearly in Plate 2 ethane forms from 25 to 40 per cent. of the gas evolved in the 300° to 350° interval, and its percentage diminishes quite regularly to a very small percentage in the 450° to 500° fraction. The hydrogen, on the other hand, starts with a small figure and increases rapidly with the increasing temperature, while the methane, CH_4, also starting in small amount, increases more rapidly than the hydrogen till it reaches its maximum in the 400° to 450° interval. Between 450° and 500° it decreases both in amount and percentage. The unsaturated hydrocarbons, named illuminants in the charts, decrease with increasing temperature, starting at about 8 per cent. in the Pittsburgh and Michigan coals and decreasing to about zero at 500°. Of the oxygen compounds carbon dioxide is, as was to be expected, higher in the Illinois and Michigan coals with their high oxygen content than in the Pittsburgh coal. In each case it decreases for a time with increase in temperature, but in the case of the Illinois and Michigan coals increases again. Carbon monoxide is present in the first fraction to about the same amount as in illuminating gas and gradually decreases in amount.

If this were ever to be a commercial process, there would probably be no attempt made to separate the fractions. The data from the various fractions had been combined in the following table to show the total yield and average composition of the gas:

Average Yield and Composition of Gas from Destructive Distillation of Coals when Heated for 6 to 8 Hours at Temperatures of 300°–450° or 500° C.

	Pittsburgh Coal.	Bay City Coal.	Zeigler Coal.
Vol. gas per pound coal, cubic feet...	1.42	1.15	0.63
Average composition of gas:			
CO_2.....	2.9	16.2	13.1
Illuminants.....	2.2	4.1	1.6
CO.....	6.2	5.0	5.8
H_2.....	26.3	16.4	13.9
CH_4.....	47.0	37.8	38.0
C_2H_6.....	13.2	11.8	19.5
N_2.....	2.7	9.1	7.8
Calculated heat value, B.T.U. per cu. ft.	902.0	778.0	871.0
Calculated heat value, assuming CO_2 eliminated.....	930.0	926.0	1,001.0

The volume of the gas is small in every case as compared with the amount obtained from distillation in the usual gas retorts, but the heating value of the gas from the Pittsburgh coal is better than natural gas, while that from the other coals, even with their higher carbon dioxide, is almost as good, and if the carbon dioxide should be removed would be of equal value.

The amount of gas was too small for candle power tests, and the composition of the gas is so different from that usually met with that an estimate of the candle power would be little more than a guess. It could certainly be superior to natural gas and might rank with the average illuminating gas.

The composition of the gas in the 300°–450° fractions, with its high methane, its ethane and its low hydrogen, is in some respects more similar to natural gas than to coal gas. It has frequently been assumed that natural gas has been thus formed by destructive distillation, with later elimination of the unsaturated gases. Thus the ethane of natural gas has been assumed to have been formed by the direct addition of H_2 and C_2H_4 giving C_2H_6. We have here, however, ethane formed apparently as a primary product in a gas containing only small amounts of hydrogen and unsaturated hydrocarbons, which would favor the theory that the ethane in the natural gas is also a primary product. The fact that ethane is absent from the gas obtained at temperatures of 500° would tend to indicate that natural gas containing ethane had been evolved at temperatures somewhat below that point.

Discussion of Results.—These experiments, on slowly heating 5 American bituminous coals of widely differing classes to a temperature of 500° C. as a maximum, give results in general agreement with those obtained by other investigators so far as others have previously covered the field. Coals which are originally non-coking are not improved in this respect, even though the ratio of oxygen to hydrogen in the coal may be brought to the supposedly favorable 2 to 1 ratio. The coking coals which were tested sintered together during the heating, and if the resultant mass was heated to redness it retained its shape and gave a good coke. If, however, it was powdered before the coking test, the powder stayed as such in the coking test. The coking constituent of the coal is evidently destroyed by heating to 500° C. The coal loses from one-third to one-quarter in weight during the process of heating to 500°, the resultant product being lower in volatile matter and, in the case of coals, initially high in oxygen, higher in heating value than the original coal. The claims for coalite are confirmed to that extent.

The distillation products are mostly watery liquids with some light, oily tar. Gas evolution commences only above 300° and the total amount is only about 1 to 1½ cubic feet per pound of coal, but it is of good quality. Ethane is an unusual constituent of the gas and, together with methane, forms the principal constituents of the gases evolved between 300° and 400° C. The ethane is almost entirely absent from the 450°–500° fractions. It is suggested that this is an indication that natural gas in which ethane is present, has been formed at lower temperature than 500° C.

So far as can be foretold from these small scale tests a process such as this could be a commercial success only under rather unusual conditions. It can hardly be successful as a method of manufacturing illuminating gas because of the low yield. There may be products of unusual value in the liquid distillates, but it is not known that such is the case. The resultant coal may sometimes have a higher and sometimes a lower heating value than the usual gas coke, but in the case of gas coals the yield of modified coal by this process is apparently not much greater than the usual yield of coke, and it would not seem that the process could be commercially successful as one for making prepared fuel. A possible promising field of limited extent may be indicated by the sintering together of fine particles of coking

coals at this low temperature. It may be possible in this way to briquette fine coking coal and make a marketable article out of a waste one.

A consideration of the bearing of these experiments on the theory of the manufacture of illuminating gas from coal in the usual manner, indicates that the secondary reactions which take place in the gas retort are perhaps more important than the primary ones. The products evolved from the coal at a relatively low temperature are subjected to reacting forces of increasing intensity as they filter through hot coke or come in contact with the hot walls of the retort. The product we desire is an intermediate one. Too vigorous a secondary action gives a poor product. Too weak a secondary action allows too much of the liquid product to slip through undecomposed and cuts down the yield of gas. The horizontal retorts tend to cause too great a secondary reaction as the gas sweeps through the narrow space under the hot crown of the retort. Vertical retorts with the gas preferably passing up through the still unchanged and cool charge in the center of the retort should avoid this difficulty, but there is the theoretical danger that they might tend toward the other horn of the dilemma and give too weak a secondary distillation.

The results are interesting and suggest many additional experiments which we hope may be carried out at some future day.

[Concluded from Page 580.]

Gas Engine Failures.[1]

In the account of failures there is instruction as to what to avoid to attain greater success, and therefore no excuse is required for dipping a little deeper into the report of Mr. Michael Longridge for illustration of the causes of the breakdown of gas engines during 1907. Each instance selected contains a lesson.

Take the statement of an accident to a horizontal gas engine, 6 years old, with cylinder 16 inches diameter by 23-inch stroke, running at 160 revolutions per minute. The cylinder was connected to the target end of the bedplate by 6 studs 1¼-inch diameter, screwed into the latter and passing through 6 lugs cast upon the front end of the cylinder jacket at equal distances round its circumference and by nuts behind the lugs. These lugs were not faced across to bed upon the target end, but were set back from the faced surface of the jacket, so that there was a space of ⅛ inch between them and the face of the target end. Thus by tightening the bolts the lugs were submitted to a bending and shearing stress, which, in the case of one of them, seems to have been high enough to start a crack. The studs were screwed 5 threads per inch; so that for every inch of length of key used for tightening the nut the load upon the bolt was 31 times the pull upon the end of the key. The ordinary spanner for a 1¼-inch nut would be about 24 inches long, so that the very moderate two-handed pull of 100 pounds exerted 4 inches from the end of the spanner would put a load of 62,000 pounds upon the bolt. If the leverage were increased by sticking a piece of pipe on to the end of the spanner, or the force intensified by striking it with a sledge hammer, the load on the bolt and the strain on the casting could easily be increased beyond the resistance of the cast iron. As the nuts had been tightened since the engine was erected at the works, on account of the cylinder springing, it is probable that the crack was started in this way, and had gradually extended until it was discovered by the attendant when cleaning the engine.

There is, too, the case of a horizontal gas engine, 6 years old, running at 250 revolutions per minute, with town gas. The cylinder was 4½ inches diameter by 7½ inches stroke. The connecting rod big end was of the marine type, with 2 bolts ½-inch diameter reduced to $\frac{7}{16}$ inch in the middle of the shank. As the crankpin began to knock, the brasses were taken off and stripped. When put back, the knocking was worse than before, and it suddenly became so bad that the attendant stopped the engine to see what was the matter. He found the upper of the two big end bolts broken through the bottom of the thread next the shank and the other bent. The inspector who examined the engine after the breakage found that the screw thread had not been continued far enough down the shank to allow the brasses to be tightened after, and possibly even before they had been stripped. The long continued succession of blows upon the bolts while the engine was running with slack brasses, culminating in still heavier blows after the brasses had been stripped, had probably started and completed the fracture. The stress on the bolts due to the inertia of the moving parts was about 500 pounds, or about 2,050 pounds per square inch of sectional area.

A flywheel mishap deserves extended consideration. The gas engine was a horizontal one, 13 months old, driving machine tools with gas from the town main. The cylinder of the engine was 10 inches in diameter; the stroke of the piston, 18 inches; and the speed, 170 revolutions a minute. The engine had 2 flywheels, each 5 feet 3 inches diameter, cast solid, with 6 curved arms and boss 9 inches diameter without hoops. The center of one wheel was 17½ inches from the right hand end of the shaft, and the center of the other 35½ inches from the left hand end, which also carried the driving pulley. The shaft was 4½ inches diameter without swells for the wheels, which were secured each by a single sunk key. The flywheel on the left hand end of the shaft collapsed suddenly while the engine was driving its usual load. The boss was split through the keyway; all the arms were snapped off near the rim, and five of them near the boss as well. The rim was not broken, neither did it bend the shaft, tear the latter out of its bearings, nor break the belt pulley. On the contrary, it somehow mounted upon the rim of the latter and wedged itself fast upon it. The cause of the breakdown was an ill-fitting key. An examination of the parts after the breakdown showed that the upper surface of the key was polished by rubbing and the edges bruised, while the lower surface had only been in contact with the shaft at the edges. The sides of the key were also rubbed bright and slightly indented by the edges of the keyway in the shaft, which were themselves slightly burred by the pressure of the key. The internal surface of the boss of the wheel, including the keyway, was battered and polished by rubbing, as also was the surface of the shaft which had been in contact with it. Apparently the key had originally fitted hard against the sides of the keyway in the shaft, and more lightly against the bed of the keyway in the boss. The boss had not fitted the shaft, and the surfaces of the shaft rubbing against the sides of the key had been too small to bear the pressure without deformation and wear. The key thus loosened allowed the wheel to rock and split the boss from one corner of the keyway.

The case is mentioned because it is typical, and Mr. Longridge thinks that the numerous cases of which it is a type suggest that the ordinary system of casting the flywheels of gas engines with solid bosses, and securing them with one or two sunk keys, might advantageously be changed. There are two objections to it. First, that if the shafts are made parallel, as they usually are except for large engines, and if they are long enough to carry a driving pulley outside the flywheel, there is difficulty in forcing a tightly fitting wheel home, especially if the wheel has to be put on after the engine has been erected at the purchaser's works. The other difficulty is in sinking the key-bed deep enough without unduly weakening the shaft and in fitting the key accurately to it. The only way to make a sunk key of the ordinary dimensions effective would be to make it fit top, bottom and both sides in a wheel and shaft tightly fitting each other. Then there would be no room for any deformation from plastic flow of the materials and the key would probably keep tight. But such fitting is a practical impossibility. The fitter must choose between the top and bottom surfaces of the key on the one hand and the side of the key on the other. In the first case the key is too narrow; in the second, the bearing surface, particularly upon the shaft, is too small. If it be intended to hold the wheel by radial pressure, would it not be better to hang it on broad keys fitted upon flats upon the shaft, but if by tangential pressure to secure it by keys fitted as shown in Figs. 1 and 2? The objection to such keys is that the key-ways weaken the shaft, and that the pressure of the key upon the edge of a key-way in a steel shaft will have a tendency to start a crack as indicated in the figure. The better plan seems to be to split the boss of the wheel, bore it slightly smaller than the diameter of the shaft, wedge the two halves apart, slip the wheel on to the shaft, withdraw the wedge and secure by 2 or 4 strong bolts, dispensing with keys altogether. If this method be adopted, the part of the shaft gripped by the boss should be of slightly larger diameter than the part just outside it, as indicated by Figs. 3 or 4, so that the edges of the boss may not indent the skin of the shaft and start a crack.

The details of an explosion suggest reflection. The gas engine was a horizontal one 7 years old, working with town gas. The cylinder was 8 inches diameter by 16-inch stroke, and the speed 185 revolutions per minute. The engine, after running for 3 hours on the day of the accident, was stopped for about an hour. On starting again, a violent explosion occurred, shattering the frame and tearing the pieces away from the holding down bolts and cylinder. The pieces were blown about the engine room, and the cylinder, crankshaft and flywheel were displaced. The explosion was caused by the ignition of a mixture of gas and air inside the bedplate through which the air for the

1. *Journal of Gas Lighting.*

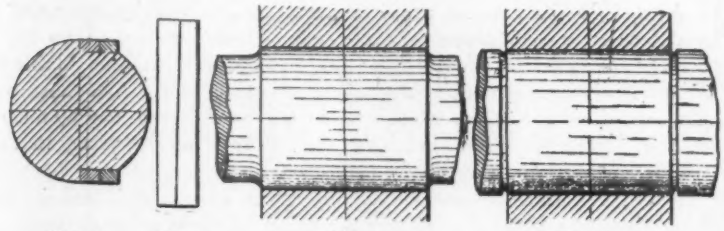


Fig. 1. Fig. 2 Fig. 3 Fig. 4.

cylinder charge was drawn. As usual in these cases, the presence of the explosive mixture inside the frame was not accounted for. It was suggested that the engine had perhaps stopped with the crank in such a position that the gas and air valves were open, and that during the stoppage some one walking past the engine had inadvertently opened the stopcock on the gas supply pipe, and thus allowed the gas to escape into the cylinder and through the open air valve into the frame. But is it really necessary to make these assumptions? Would not the same effect be produced if the driver, after opening the gas cock to start the engine, took rather more time than usual in pulling round the flywheel to make the charging stroke? In such a case it is quite possible that with gas under pressure a volume greater than the piston displacement would pass the gas cock during the suction stroke, and that the surplus would flow through the open air valve into the frame. Having once filled the supply pipe and frame with an explosive mixture, an explosion almost necessarily follows. If the air valve be leaking, it will occur on the ignition of the charge in the cylinder. If the valve be tight it will probably occur at the next opening of the air valve, for the first charge being too rich, and very slightly compressed, will probably burn so slowly that flame will linger in the cylinder throughout the exhaust stroke and ignite the incoming charge and the mixture in the frame. If the air for the cylinder be drawn through the frame, the latter should have large openings in the sides to act as safety valves in case of an explosion. It is better to draw the air through a separate box and filter with a light cover, so placed that no damage will be done if it be blown off

Explosions of gas making plants continue to occur, generally through want of understanding on the part of the attendant, but sometimes through faulty arrangement of the apparatus. The following is a fair example of such cases. The plant which exploded was a suction gas plant for supplying a horizontal engine, with cylinder 14 inches diameter by 22-inch stroke, running at 164 revolutions per minute. It consisted of the usual generator, scrubber and expansion box. The fan for blowing up the fire at starting was placed between the generator and the scrubber; and between it and the scrubber was a 3-way cock, by which the generator could be put into communication with the chimney, the scrubber, or with both simultaneously. The plug of the cock could be turned into any position. At the bottom of the chimney was a test cock. Between the scrubber and the engine there was a second chimney or escape pipe, with a stopcock. The scrubber top was blown off when preparing to start the engine.

Two accounts of the accident were given to the Company's inspector by the attendant – the first a few hours after its occurrence; the second some days later, after the latter had had time to study the printed instructions issued by the makers of the plant and to consider how far he had obeyed them. These instructions were: First, to put the generator in communication with the chimney by setting the 3-way cock to the specified position, and blow up the fire till the gas would burn freely at the test cock. Secondly, when the gas burnt freely at the test cock, to put the generator in communication with the scrubber by turning the 3-way cock to the position described, then to open the cock on the escape pipe and continue blowing to clear the scrubber and expansion box of foul gas or air and fill it with pure gas fit for use in the cylinder of the engine. Thirdly, to shut the cock on the escape pipe and start the engine. What the attendant actually did, according to his first account, was this: He put the generator in connection with the chimney, blew up the fire, opened the stopcock on the escape pipe, and lighted the gas at the mouth of the escape pipe. He then "partly closed" the 3-way cock, opened the test cock and applied a light to it, when the explosion followed. In his second account, the attendant said he followed the instructions up to the opening of the stopcock on the escape pipe and then departed from them by lighting the gas at the mouth of the escape pipe, when the gas in the pipe and scrubber exploded.

The first explanation is probably the more correct; and having regard to the design of the 3-way cock, it is easy to see how the explosion was brought about. The probability is that when the stopcock on the escape pipe was opened, the scrubber, expansion box and pipes were full of pure gas left in them when the engine stopped the previous afternoon, which would not burn until it reached the air at the mouth of the escape pipe. It is also probable that, when the fan was started, the 3-way cock was open to the scrubber as well as to the generator; so that, as soon as the stopcock on the escape pipe was opened, an explosive mixture of air and gas, or foul gas, was forced into the scrubber to take the place of the pure gas burning at the mouth of the escape pipe, and that, after being partly closed, it still allowed communication between the three. Under such circumstances it is evident that a light applied to the test cock would ignite and explode the mixture. If the second explanation be the true one, it is almost necessary to assume that the scrubber and expansion box had in some way become charged with an explosive mixture or with air during the previous night. In the first case an explosion would follow the ignition of the mixture at the mouth of the escape pipe; in the second a moment would arrive when the pure gas, being blown into the scrubber, would be mixed with the air contained therein in such proportions as to explode when brought in contact with a light. Either condition might no doubt have been produced by leaving the stopcock open or the scrubber in communication with the atmosphere through the 3-way cock and with an insufficient water seal. Only in either case one would have expected the expansion box rather than the scrubber to have suffered.

By appropriate manipulation of the cocks, with suitable mixtures of gas and air in the scrubber and expansion box, an inexperienced person, like the attendant in this case (who had only been in charge of the plant 3 days), could doubtless produce explosions in this or other ways. But Mr. Longridge is inclined to think that the account first given was substantially correct, and that if the 3-way cock had been so constructed that it could not be opened simultaneously to the scrubber and to the atmosphere, it would have been much more difficult to have blown up the plant. But even with a properly arranged 3-way cock between the generator and the scrubber, there will always be a risk in testing the gas in the escape pipe, unless the scrubber, expansion box and pipes contain nothing but pure gas when the test is made. To minimize the risk of explosion by testing at this critical period, the test cock, as well as that on the escape pipe, should be fitted with wire gauze flame arresters.

The Calorific Power of Petroleum Oils and the Relation of Density to Calorific Power.

This exceedingly valuable notation appeared in the *Journal* of the American Chemical Society for the current month. It was contributed thereto by Messrs. H. C. Sherman and A. H. Kropff, who in turn worked out the problems in the Havemeyer Laboratories, Columbia University, New York.

The purpose of this paper is to put on record the calorific power of a considerable number of representative American petroleum oils and to point out an approximate relationship between the density and the calorific power of such oils.

While among the homologues of a given series of hydrocarbons decreasing proportions of hydrogen might be assumed to involve an increase in density and decrease in heat of combustion or calorific power, it would not necessarily follow that such a relation would obtain for the mixtures of hydrocarbons which constitute the crude petroleums or their commercial products. Nor have we been able to find in the literature sufficient comparable data to give even an approximate expression of the quantitative relation to be expected between the density and the calorific power of petroleum products.

In a previous paper from this laboratory[1] it was shown that a fairly definite relation exists between the heat of combustion and the specific gravity in fatty oils, and data were then given for three petroleum oils in which also the decrease in calorific power with increasing density was fairly regular. Since that time one of us has had occasion at intervals to determine the calorific power of petroleum oils and the results have generally tended to confirm the impression that the relation between density and calorific power, while not strictly quantitative for commercial oils, is yet sufficiently regular to be of some practical value. We have, therefore, thought it worth while to extend this investigation to include a careful determination and comparison of the heat of combustion and specific gravity in a variety of samples of known origin.

1. Sherman and Snell, "Journal Am. Chem. Soc.," 24, 349; 1902.

The samples of known origin were obtained during the summer and fall of 1907. Thirteen of these samples were kindly procured for us by Prof. C. F. Chandler through the courtesy of Mr. G. M. Sayboldt, of the Standard Oil Company; four by Prof. C. E. Lucke, from the De La Vergne Machine Company; six by Mr. T. T. Gray, chemist of the Tide-Water Oil Company; the remainder from various sources.

We desire to express our indebtedness to Professors Chandler and Lucke and Mr. Gray for the interest and assistance which greatly facilitated the collection of samples representing a wide variety of American fields and known to be typical of the petroleum oils now in use in this country.

We are also indebted to Mr. Emil Osterberg for assistance in securing a portion of the analytical data.

In the accompanying table are shown the data for 64 petroleum oils which have been so examined as to admit of comparison, with a statement of origin in all cases in which this was known. For convenience of comparison the oils are arranged in order of density and will be seen to vary from a medium light gasoline to a crude oil of exceptionally high specific gravity.

Densities and Heats of Combustion Observed and Calculated.

No.	Specific Gravity 15°-15°.	Baume Degrees.	Calories per Gram.	B.T.U. per Pound.	B.T.U. Calculated.	Percentage Error.	Description.
1	.7100	67.2	11,733	21,120	20,938	— 0.91	Gasoline.
2	.7175	65.1	11,327	20,389	20,854	+ 2.33	"
3	.7200	64.4	11,404	20,527	20,726	+ 0.99	"
4	.7709	51.6	11,132	20,038	20,314	+ 1.38	[1]
5	.7830	48.8	11,121	20,018	20,206	+ 0.92	Kerosene.
6	.7850	48.35	11,119	20,014	20,194	+ 0.89	California refined.
7	.7945	46.2	11,128	20,030	20,098	+ 0.33	West Va. crude.
8	.7950	46.1	11,186	20,135	20,094	— 0.20	Kerosene.
9	.7964	45.8	11,242	20,236	20,082	— 0.76	[1]
10	.8048	44.0	11,149	20,068	20,010	— 0.29	Ohio crude.
11	.8059	43.7	11,143	20,057	19,998	— 0.29	Penna. crude.
12	.8080	43.2	11,001	19,802	19,979	+ 0.88	California refined.
13	.8103	42.8	11,090	19,963	19,962	± 0.00	Kansas refined.
14	.8237	40.0	10,981	19,766	19,850	+ 0.42	West Va. crude.
15	.8248	39.7	11,015	19,827	19,838	+ 0.05	California refined.
16	.8261	39.5	11,123	20,021	19,830	— 0.95	West Va. crude.
17	.8321	38.2	10,972	19,757	19,778	+ 0.11	[1]
18	.8324	38.2	10,990	19,782	19,778	— 0.02	Penna. crude.
19	.8418	36.3	10,950	19,710	19,702	— 0.04	Ohio crude.
20	.8421	36.25	10,997	19,795	19,698	— 0.48	Indian Ter.
21	.8436	36.0	11,069	19,924	19,690	— 1.17	[1]
22	.8466	35.4	10,936	19,685	19,666	— 0.09	Indian Ter.
23	.8500	34.7	10,953	19,715	19,638	— 0.38	California refined.
24	.8510	34.5	10,958	19,724	19,630	— 0.47	Kansas crude.
25	.8514	34.45	10,945	19,701	19,630	— 0.35	[1]
26	.8534	34.05	10,991	19,784	19,610	— 0.86	[1]
27	.8580	33.2	10,772	19,389	19,578	+ 0.95	Kansas crude.
28	.8597	32.8	10,766	19,379	19,562	+ 0.95	Illinois crude.
29	.8616	32.5	10,967	19,741	19,550	— 0.95	[1]
30	.8640	32.05	10,867	19,555	19,530	— 0.12	California refined.
31	.8648	31.9	10,920	19,656	19,526	— 0.65	Penna. fuel oil.
32	.8660	31.65	10,864	19,555	19,516	— 0.19	Fuel oil.
33	.8670	31.5	10,850	19,530	19,510	— 0.10	Penna. fuel oil.
34	.8690	31.1	10,852	19,534	19,494	— 0.20	Indian Ter.
35	.8708	30.8	10,919	19,654	19,482	— 0.86	[1]
36	.8712	30.7	10,879	19,614	19,478	— 0.68	[1]
37	.8745	30.1	10,752	19,354	19,454	+ 0.50	Kansas crude.
38	.8773	29.6	10,794	19,429	19,434	+ 0.03	Penna. fuel oil.
39	.8800	29.0	10,804	19,447	19,410	— 0.18	Kansas crude.
40	.8807	29.0	10,797	19,435	19,410	— 0.47	[1]
41	.8810	28.9	10,797	19,435	19,406	— 0.15	
42	.8820	28.75	10,913	19,643	19,400	— 1.22	[1]
43	.8828	28.7	10,694	19,249	19,396	+ 0.73	Kansas crude.
44	.8833	28.5	10,819	19,474	19,390	— 0.42	[1]
45	.8860	28.0	10,808	19,454	19,370	— 0.42	Indian Ter.
46	.8862	28.0	10,762	19,370	19,370	— 0.01	[1]
47	.8900	27.3	10,788	19,418	19,342	— 0.39	Indian Ter.
48	.8914	27.1	10,690	19,242	19,332	+ 0.45	Texas crude.
49	.8970	26.1	10,753	19,355	19,294	— 0.31	
50	.9007	25.4	10,755	19,359	19,267	— 0.47	[1]
51	.9050	24.7	10,682	19,228	19,238	+ 0.05	
52	.9065	24.45	10,751	19,352	19.228	— 0.63	[1]
53	.9066	24.4	10,605	19,089	19,226	+ 0.69	Kansas crude.
54	.9087	24.1	10,712	19,282	19,213	— 0.35	
55	.9114	23.6	10,724	19,303	19,194	— 0.55	Kansas crude.
56	.9137	23.2	10,571	19,028	19,178	+ 0.76	Texas crude.
57	.9153	22.95	10,692	19,246	19,168	— 0.39	"
58	.9155	22.9	10,560	19,008	19,166	+ 0.80	"
59	.9158	22.9	10,318	18,572	19,166	+ 2.58	California crude.
60	.9170	22.7	10,613	19,103	19,157	+ 0.28	Fuel oil.
61	.9179	22.5	10,433	18,779	19,150	+ 1.94	California crude.
62	.9182	22.5	10,547	18,985	19,149	+ 0.83	"
63	.9336	20.0	10,600	19,080	19,048	— 0.16	Texas crude.
64	.9644	15.2	10,327	18,589	18,858	+ 1.42	California crude.

1. Obtained by fractional distillation of commercial fuel or gas oils—Nos. 4, 25, 30, 44 and 52 were the successive fifths from one sample; Nos. 9, 21, 26, 2) and 42 from a second; Nos. 17, 35, 40, 46 and 50 from a third.

As a rule the specific gravities were determined by means of a pyrnometer and the corresponding Baume numbers are taken from the specific gravities according to the "American standard" table as given in *Van Nostrand's Chemical Annual*, 1907. The heats of combustion or calorific powers were in all cases determined by means of the Atwater-Mahler apparatus and method as described in our previous paper[1] and more fully by Atwater and Snell.[2]

It will be seen that throughout the range of oils included in the table there is a general tendency toward a fairly regular decrease in calorific power as the specific gravity increases and the Baume numbers decrease.

In the cases in which an approximate estimate of the calorific power is most likely to be useful, the expression of density in terms of the Baume scale and of calorific power in British thermal units per pound will probably be most common.[3] By grouping the samples falling within certain limits of Baume density and plotting the average figures, it was found that the approximate average relation between Baume density and calorific power in B.T.U. may be expressed as follows:

$$\text{B.T.U.} = 18{,}650 + 40\ (\text{Baume} - 10).$$

This formula was then applied to the data of the individual samples. In the columns headed "B.T.U. Calculated" and "Percentage Error" are given for each sample the calculated B.T.U's and the percentage difference between the calculated and the determined values.

It will be seen that the difference between the calorific power as determined in the bomb calorimeter and as calculated from the formula here proposed is usually small. In only one-ninth of the cases is the difference greater than 1 per cent., in only one-thirtieth is it greater than 2 per cent., in no case is it as great as 3 per cent. The samples examined were all believed to be of fair average commercial purity; the discrepancies might readily be larger in oils grossly contaminated with water or suspended matter, but the majority of such cases could probably be recognized by superficial examination.

In view of the number of samples examined and the fact that about half of them were selected as representative of the produets of the principal oil fields of the United States, while the remainder were taken at random from commercial sources, it would seem safe to infer that for commercially pure samples of ordinary American petroleum oils, varying from heavy crudes to gasoline, the calorific power may be predicted from the density with about as close an approximation to accuracy as is usually obtained in calculating fuel values from chemical analyses.

If it be desired to estimate the calorific power in terms of calories per gram, or to base the estimate upon specific gravity, or both, it need only be remembered that calories per gram × 1.8 = B.T.U. per pound, and that specific gravity $= \frac{140}{130 + \text{B}}$, according to the standard used in obtaining the Baume figures here given; or the following estimate may be used, which being obviously only an approximate indication, is perhaps less likely to be misleading than is a formula:

A specific gravity	0.7 –0.75	indicates about	11,700–11,350	calories.
A "	0.75–0.8	"	11,350–11,100	"
A "	0.8 –0.85	"	11,100–10,875	"
A "	0.85–0.9	"	10,875–10,675	"
A "	0.9 –0.95	"	10,675–10,500	"

Of the 63 samples here examined which fall within these limits of specific gravity, only two fall outside of the indicated range of calorific power by as much as 100 calories, and only seven by as much as 50 calories.

Summary.—Sixty-four samples of petroleum oils, ranging from heavy crude oil to gasoline, and representing the products of the principal oil fields of the United States, were examined for calorific power by combustion in oxygen in the Atwater-Mahler bomb calorimeter with results ranging from 10,318 to 11,733 calories per gram, or 18,572 to 21,120 B.T.U.'s per pound.

In general the decrease in calorific power with increase in specific gravity was fairly regular, so that the relation between the two may be expressed approximately by means of a simple formula. When the calorific powers calculated from the densities by means of this formula were compared with those actually determined, it was found that in one-ninth of the cases the difference was greater, and in eight-ninths it was less than 1 per cent.; in only one-thirtieth was it greater than 2 per cent.; in no case was it as great as 3 per cent.

1. Sherman and Snell, *loc. cit.*

2. "Journal Am. Chem. Soc.," 25, 659; 1903.

3. It should perhaps be noted that the heavier oils with lower calorific power per gram or per pound would show higher calorific power *per gallon* than the light oils.

While it is obviously improbable that an exact quantitative relation should exist, it is believed that from the data here given the calorific power of commercially pure petroleum oils may be predicted from the density with a sufficient approach to accuracy for many practical purposes.

Savings from the Retort Coke Process: A Computation for 1907.[1]

A summary of the report of Edward W. Parker on the "Manufacture of Coke in 1907," as issued by the United States Geological Survey, appeared in the *Iron Age* of August 20, page 511. The complete report has now been published and we take from it the discussion of the present status of the by-product coke industry in the United States and the argument for its more rapid extension:

When the economies which may be effected by the use of the retort ovens have been so clearly demonstrated, not only by the plants which have been constructed in the United States, but more emphatically through the much more extensive development of by-product coke manufacture in Europe, the condition in the United States, as shown by the statistics for the last 4 years, is somewhat difficult to understand. The economy shown by the higher yield of coal in coke has already been referred to, and, as previously stated, the production of coke in the by-product ovens of the United States in 1907 amounted to 5,607,899 net tons, valued at $21,665,157. The total value of by-products obtained in the manufacture of this coke was $7,548,071, this value and the quantity being distributed as follows:

Value of By-Products Obtained in Manufacture of Coke in Retort Ovens in 1907.

	Quantity.	Value.
Gas, 1,000 cubic feet	20,516,731	$3,130,839
Tar, gallons	53,995,795	1,242,530
Ammonia, sulphate or reduced to equivalent in sulphate, pounds	125,372,360	3,174,702
Totals	....	$7,548,071

The gas included in the foregoing statement is the "surplus" not consumed in the coking process, and which is either sold or used at manufacturing establishments operated in connection with the coke oven plant. In a few instances where the surplus gas is consumed by the producing companies the quantity is not measured, nor was any value placed upon it in the reports made to the survey. In such cases careful estimates have been made, based upon the average surplus gas obtained from similar coals used at ovens of the same type. The value, similarly estimated, has been placed at from 10 to 15 cents per 1,000 cubic feet.

The Waste of Beehive Ovens Calculated.—The coal consumed in retort ovens in 1907 amounted to 7,460,587 short tons. The quantity of coal used in beehive ovens was 54,485,522 short tons, from all of which the possible by-products are apparently wasted. Assuming that the coal consumed in beehive ovens was of the same average quality as that charged into the retort ovens and that the prices would be not less than 80 per cent. of those ruling in 1907, the value of recoverable products which were thus apparently wasted last year amounted to $44,000,000, a sum equal to nearly 80 per cent. of the total value of all the coal used in beehive ovens during the year. At the prices which prevailed in 1907 the value of the by-products wasted in beehive coke ovens was a little over $55,000,000.

The value of the by-products from the retort ovens in 1907 was a little more than one-third the value of the coke produced in them. It should be remembered, however, that beehive ovens are located in the coal mining regions and that the cost of the coal charged into them represents only a little more than that represented by the expense of mining the coal, whereas in locating by-product recovery plants provision must be made for utilizing or marketing the by-products. It is for this reason that in the much larger number of cases the recovery plants are established near the larger cities and at considerable distances from the mining regions, and the expense of transportation is added to the mining cost of the coal. Hence it is that the value of the 7,506,174 tons of coal charged into by-product ovens in 1907 was $15,874,430, or over $2 per ton, while the 54,485,522 tons of coal used in beehive ovens was $56,956,008, or $1.05 per ton. It must also be remembered that the original cost of installation for a by-product recovery plant is from four to five times that of a beehive plant of equal capacity. These disadvantages are in turn partly offset by the higher percentage yield of coke in the retort ovens and a lower delivery charge on the coke produced. In the case of behive coke, railroad transportation expense is borne by the coke, while in retort oven practice all, or nearly all, of the freight charge is borne by the coal.

The total value of the 5,607,899 tons of by-product coke produced in 1907 was $21,665,157, an average of $3.86 per ton. The value of the 35,171,665 tons of beehive coke made in 1907 was $89,873,969, or $2.56 per ton. If we consider that the difference in the value of the by-product coke and beehive coke was due only to the difference in freight charges, then the total value of the entire product of beehive coke made in 1907 would, if made in retort ovens close to the market, have been worth $135,750,000. Add to this the value of the by-products that should have been recovered of $44,000,000, at 80 per cent. of the market price in 1907, the total value of the coke and by-products would have amounted to nearly $180,000,000 instead of the value of $89,873,969 for the beehive coke alone. The value of the coal charged into these ovens would have been $108,879,870 instead of $56,956,008. Carrying the hypothesis further, the difference between the value of the coke and by-products, if the coal had been coked in retort ovens, and the value of the coke alone from the beehive ovens was, say, $90,000,000. From this should be deducted the difference between what the value of the coal would have been at retort ovens and what it was at beehive ovens—*i. e.*, $52,000,000. The remainder, $38,000,000, less the difference in operating expenses, wear and tear, interest on capital, etc., may be considered as approximately the actual net loss in value as the result of beehive coke production compared with by-product coke practice in 1907.

The Lack of Market for Tar Products.—One of the reasons that has been given for the apparent lack of progress in retort oven building in the last 4 years is the lack of profitable markets for the by-products of coal tar, and this has contributed to the backwardness of the United States in the development of the chemical industries depending upon coal tar as a raw material, and yet this country is importing coal tar products to the value of several million dollars annually. It is also well known that the development of the coal briquetting industry has been retarded because of the lack of assurance of a satisfactory supply of suitable coal tar pitch for binding material, and there is also an increasing demand for creosoting oils for the preservation of timber. The accompanying table shows the value of the coal tar products imported into the United States and the duty paid thereon in each year since 1896, inclusive.

There does not appear to be any trouble in disposing of the ammonia, for which a good demand exists, and the practicability of long distance transmission of the gas has been successfully demonstrated, thus insuring markets for the surplus of this retort oven product. The United Otto oven plant at Camden, N. J., is distributing gas to Plainfield, New Brunswick and other cities and towns, the maximum distance being 83 miles. At the present time, when the conservation of the natural resources of the United States is being so earnestly discussed, this matter of waste in coke manufacture is one which might well be given serious consideration.

At the close of 1907 there were 1,270 Semet-Solvay ovens in operation, with 25 idle; of the United Otto type there were 2,002 completed and 50 building. In addition to these there were 387 Rothberg ovens in operation during the year, but no new ones of this type were under construction. There were also 152 Newton-Chambers ovens in operation at Vintondale, Pa., during 1907, but no by-products, except of an experimental character, were obtained. The plant of 56 Newton-Chambers ovens constructed at Pocahontas, Va., has not been in operation for several years.

1. *Iron Age.*

Coal Tar Products Imported into the United States, 1896–1907.

Year.	Salicylic Acid.		Alizarine and Colors or Dyes, Natural and Artificial. No Duty. Value.	Aniline Salts. No Duty. Value.	Coal Tar Colors or Dyes, not Specially Provided for		Coal Tar, all Preparations, not Colors or Dyes.		Coal Tar Products, not Medicinal, not Dyes, known as Benzol, Toluol, etc. No Duty. Value.	Total.	
	Value.	Duty.			Value.	Duty.	Value.	Duty.		Value.	Duty.
1896*....	$138,013	Free	$994,395	$662,459	$2,918,333	$729,583	.....	.....	.....	$4,713,200	$729,583
1897*....	201,980	Free	1,023,425	812,884	3,163,182	790,796	.....	.....	....	5,201,471	790,796
1898*....	28,688	$6,794	886,349	1,087,704	3,723,288	1,098,532	$134,416	$26,883	$228,037	6,088,482	1,132,209
1899*....	57,192	18,536	700,786	743,130	3,900,099	1,170,030	221,101	44,220	393,602	6,015,910	1,232,786
1900*....	89,175	24,069	771,336	537,812	4,792,103	1,437,631	274,946	54,989	397,780	6,863,152	1,516,689
1901.....	76,786	22,227	713,392	589,535	4,034,171	1,210,251	342,116	68,423	383,559	6,139,559	1,300,901
1902.....	57,852	21,913	1,028,327	631,467	4,911,668	1,473,500	496,928	99,386	368,098	7,494,340	1,594,799
1903.....	19,012	7,827	660,464	789,553	5,252,611	1,575,783	544,176	108,835	425,069	7,690,885	1,692,445
1904.....	7,305	3,276	636,418	686,184	4,903,077	1,470,923	522,242	104,448	391,645	7,146,871	1,578,647
1905.....	2,214	923	625,491	789,052	5,673,242	1,701,973	768,556	153,711	486,439	8,344,994	1,856,607
1906.....	2,772	991	661,155	806,901	5,717,932	1,715,380	864,067	172,814	483,416	8,536,243	1,889,185
1907.....	1,240	489	782,368	667,758	5,830,651	1,749,196	911,096	182,219	653,288	8,846,401	1,931,904

* Fiscal years.

In the following table is shown the record of by-product coke making since 1893, when the first plant was established at Syracuse, N. Y.:

Record of By-Product Coke Making, 1893-1907.

Year.	Ovens.		Production, Net Tons.	Year.	Ovens.		Production, Net Tons.
	Built.	Building.			Built.	Building.	
1893....	12	0	12,850	1901....	1,165	1,533	1,179,900
1894....	12	60	16,500	1902....	1,663	1,346	1,403,588
1895....	72	60	18,521	1903....	1,956	1,335	1,882,394
1896....	160	120	83,038	1904....	2,910	832	2,608,229
1897....	280	240	261,912	1905....	3,159	417	3,462,348
1898....	520	500	294,445	1906....	3,603	112	4,558,127
1899....	1,020	65	906,534	1907....	*3,892	†330	5,607,899
1900....	1,085	1,096	1,075,727	.....	.....	.....	.....

* Includes 1,275 Semet-Solvay, 2,008 United Otto, 337 Rothberg and 203 Newton-Chambers ovens. † Includes 50 United Otto and 280 Koppers ovens.

Bureau of Information, The American Gas Institute.

BUREAU OF INFORMATION,
THE AMERICAN GAS INSTITUTE,
HEADQUARTERS, 716 LOCUST STREET, ST. LOUIS, MO.
W. A. BAEHR, Chairman.

Question No. 33.—"Is it reasonable to assume that gas is generally saturated with water vapor at the temperature at which it is metered, and, if so, should not this water vapor be taken into consideration in correcting to the corresponding volume of the gas at some arbitrary temperature, such as 60° F.? If this is the case, what then is the proper correction formula, or will you give a curve showing corrections between 60° F. and 100° F. The present practice of many modern gas works of purifying their gas at a high temperature make the proper correction to be applied of great importance."

ANSWER BY THE BUREAU OF INFORMATION.

In endeavoring to compile an answer to this question, the Bureau encountered considerable difficulty and lack of experimental data; therefore, one of the members of the Bureau kindly volunteered to have carried out a series of experiments, which are set forth hereinafter.

These experiments were made by Messrs. F. E. Park, Chemist, and J. W. Battin, Superintendent Station "A," Detroit City Gas Company. The Bureau did not wish to consider the results of the experiments which these gentlemen made in the light of an answer-at-large, and, therefore, did not publish the results of their work as such, but nevertheless the Bureau desires to extend credit to these gentlemen for the work they have done in this instance. The experiments, together with the method of altering the formula to suit the particular instance covered by the experiments, are as follows—below are results of passing dry gas through a small candle power test meter, at the rate of 5 cubic feet per hour, noting ability of dry gas to pick up moisture at this rate and the effect on accuracy of measurement:

Temperature, Degs. F.	Saturated.	Correction to be Added.
60.2	86.2 per cent.	0.25 per cent.
61.0	75.6 "	0.45 "
64.2	67.5 "	0.68 "
66.0	68.3 "	0.70 "
67.3	94.9 "	0.12 "
69.7	71.9 "	0.71 "
71.0	83.3 "	0.44 "
75.6	83.3 "	0.17 "
77.0	74.1 "	0.84 "
80.5	80.3 "	0.73 "
80.5	82.1 "	0.66 "
85.0	74.3 "	1.09 "
85.0	71.7 "	1.20 "
90.0	88.4 "	0.59 "
91.0	86.8 "	0.69 "
94.8	91.8 "	0.49 "
98.3	97.9 "	0.14 "
102.0	95.8 "	0.32 "
Average	81.8	0.57

The following tests were made of the saturation of the gas with water vapor at the outlet of a large wet meter. The gas used was coal gas, which had been cooled at 75° F., and at the outlet of the rotary scrubber raised to 110° F. by means of exhaust steam. It then passed through the purifiers and thence through a line of 24-inch pipe about 600 yards long. From here it passed into and through the wet meter.

Temperature. Degrees F.	Saturated.	Correction to be Added.
88.0	77.2 per cent.	1.11 per cent.
88.0	75.3 "	1.20 "
91.0	83.7 "	0.86 "
91.0	79.5 "	1.07 "
93.5	80.0 "	1.13 "
93.5	76.5 "	1.33 "
Average	78.7 "	1.12 "

The following test and check were made at outlet of coal gas proportional meter at lower by-pass valve:

Temperature. Degrees F.	Saturated.	Correction to be Added.
122	70.5 per cent.	4.00 per cent.
122	74.4 "	3.60 "
Average	72.5 "	3.80 "

The result at the proportional meter is likely in error, due to the high temperature. The following formula was used to determine the weight of water in saturated gas:

V = Volume of gas in cubic feet, as measured.

B = Barometric pressure, in inches.

P_t = Vapor pressure of water, in inches, at temperature "t" degrees F.

$$\frac{V\,P_t}{B} \times \frac{520}{460 + t} \times \frac{30}{B} \times \frac{18}{0.834} = \frac{V\,P_t \times 336{,}700}{B^2\,(460 + t)}$$

520 is the absolute temperature at 60° F., 450 + t is the absolute temperature at t° F., and 0.834 is the molecular volume in cubic feet at 30 inches barometer pressure and 60° F.

This formula checks with the Smithsonian Institute tables. Vapor pressure values were taken from Regnault's tables.

In figuring the gas passing the meter in the tests at the outlet of large meters, a correction of 0.57 per cent. was added to the gas measured, as this was a case where dry gas was being measured through a candle power test meter at the rate of 5 cubic feet per hour. The same meter was used as in the tests on dry gas. The effect of this correction on the results is negligible. In each test half a cubic foot was run, and two calcium chloride tubes were used in the train. All but 5 per cent. of the moisture was caught in the first tube. The tubes were weighed to milligrammes. It was not possible to get results below 80° F. without artificially cooling the gas. The results with dry gas would indicate that the per cent. of saturation does not change much between 60 F. and 80° F. In the light of the above tests the proper correction formula would be as follows:

$$N = \frac{17.64\,(h - 0.787\,a)}{460 + t}$$

or,
$$V_{ss} = V_t\,\frac{17.64\,(h - 0.787\,a)}{460 + t}$$

h = observed barometer;
a = vapor pressure at t° F.

To derive the Gas Referee's formula: Considering temperature alone on a perfect gas, we have:

$$\frac{V_{ss}}{Vt} = \frac{460 + 60}{460 + t} = \frac{520}{460 + t}.$$

Considering the barometric pressure, and also the temperature effect on the gas saturated with water vapor at t° F., and at 60° F. we get:

$$\frac{V_{ss}}{Vt} = \frac{h - at}{30 - a\,60} = \frac{h - a}{30 - 0.52} = \frac{h - a}{29.48}$$

Combining the two equations, we get:

$$\frac{V_{ss}}{Vt} = \frac{520\,(h - a)}{29.48\,(460 + t)} \text{ or } N = \frac{17.64\,(h - a)}{460 + t}$$

To derive this formula by another method:

$$Vo = Vt\,\frac{h - a}{30\,(1 + \frac{t - 32}{492})} = Vt\,\frac{492\,(h - a)}{30\,(460 + t)} = V_{ss}\,\frac{h - a}{30\,(1 + \frac{t - 32}{492})}$$

$$= V_{ss}\,\frac{492\,(h - 0.52)}{30\,(460 + 60)}$$

Then, $$\frac{V_{ss}}{Vt} = \frac{492\,(h - a)}{30\,(460 + t)} \times \frac{30\,(520)}{492\,(h - 0.52)} = \frac{520\,(h - a)}{(h - 0.52)(460 + t)}$$

But at 60° F., h = 30; therefore,

$$V_{ss} = Vt\,\frac{520\,(h - a)}{29.48\,(460 + t)} = Vt\,\frac{17.64\,(h - a)}{460 + t}$$

or,

$$N = \frac{17.64\,(h - a)}{460 + t}$$

In commenting on the particular experiments by Messrs. Park and Battin, the Bureau wishes to state as follows:

The question inquires, "Should not this water vapor be taken into consideration in correcting to the corresponding volume of the gas at some arbitrary temperature such as 60° F.?" As shown by Messrs. Park and Battin, the ordinary tables of gas correction factors are computed from the formula—

$$\text{Correction factor} = N = \frac{17.64\ (h - a)}{460 + t}$$

which covers the effect of water vapor upon the volume of the gas. Consequently, these tables already effect the result recommended by the question.

Messrs. Park and Battin's experiments appear to show the possibility, at least under certain conditions, of a gas not completely saturated with water vapor passing over water and still failing to thereby become saturated with its vapor. It is easy to believe that this will be the case where, for instance, the surface of the water is more or less covered with oil, which will doubtless greatly retard the evaporation of water; it may even be true where the surface of the water is free from oil, but a somewhat dry gas passes over it rapidly, or where the gas is exceedingly dry, as was the case in some of these experiments. Consequently, for instance, it is possible for a gas which has been cooled and its moisture precipitated to thereafter pass through, say, a station meter and emerge only partially saturated.

If, however, a gas is thoroughly water vapor saturated at any point in the works, and thereafter *steadily* falls in temperature, there seems no reason that it should not at every such lower temperature remain completely saturated with water vapor, and the ordinary table of correction factors will apply to the correction of its volume to 60°.

As is shown by these gentlemen, under ordinary conditions and at ordinary temperature the gas is somewhere near saturation, and the error caused by using the ordinary table of correction factors is small. The only *absolutely* correct method, however, appears to be to determine the percentage of water vapor saturation actually existing in the gas and substitute this percentage in the general formula, as has been done by them, they obtaining the modified formula, for 78.7 per cent. saturation—

$$V_{s_0} = V_t\,\frac{17.64\ (h - .787\ a)}{460 + t}$$

It would hardly be proper to consider the experimental data hereinbefore submitted as entirely conclusive, or as a proper basis for a general answer to the question. The conditions in practice and in various plants are different, and the Bureau would state that, in any particular instance, it would be probably advisable to make long series of experimental determinations at the plant in question, and considerable study of the matter before a departure from the Referee's formula for the correction of gases should be undertaken at the works in question.

Question No. 34.—"In general, have those interested in the gas business found the hygrometer described in the paper 'Delivery of Uniform Candle Power to the Consumers through all Seasons of the Year,' read before the Institute in 1907, a reliable and accurate instrument?"

ANSWER BY THE BUREAU OF INFORMATION.

The hygrometer, as described in the paper alluded to in the question, was designed to afford a means of obtaining, with a fair degree of accuracy, a quick determination of the dewpoint of illuminating gas for hydrocarbon vapors and for water at any point in the mains or works. The scope of the use of the instrument is not here brought into question. The instrument follows closely upon the scientific principles of the instrument designed by Regnault (see Annales de Chemie et de Physique, 3-XV., 129). In describing his instrument and method of operation Regnault says:

"All these operations take more time to describe than to execute; with a little practice 3 or 4 minutes are necessary for determining the dewpoint almost within $\frac{1}{10}$° C."

When we consider the length of time in which these principles have been in use without suspicion being excited as to the accuracy, it may be considered that the hygrometer has been accepted as an accurate instrument for a long time by scientific men.

The instrument has been tested many times against other methods of determining the dewpoint, and the following results were recently obtained on a freezing coil experiment at one of the works in Philadelphia:

Temperature Shown on Coil. Degrees F.	Temperature Indicated by Hygrometer. Degrees F.
80	80
70	70
60	60
50	50
40	40
35	36

That is to say, when the gas was chilled by being passed through a down coil to a temperature lower than that which it had before experienced, the thermometer at the bottom of the down coil showed the same temperature as the dewpoint ascertained by the use of the hygrometer.

On a test in the laboratory, the gas from the laboratory pipes was tested with a hygrometer and it was found that 71° F. was the dewpoint of the water vapor. A gravimetric determination was then made and water was found corresponding to 72° F. On a second test the gas was passed through a freezing coil, the thermometer in the gas showing that it has been subjected to a temperature of 34° F. The moisture was then determined with calcium chloride, and found to be sufficient to saturate the gas at 33.5° F., while the hygrometer showed 34° F.

It was pointed out in the paper mentioned that the determination of the temperature of the gas by a thermometer at the point at which it was to be tested would not generally be reliable in showing the temperature at which the gas was saturated with hydrocarbon vapor. It was also shown that this latter knowledge was necessary to secure a uniform candle power at the testing station, because if the gas had been cooled to a considerable extent, and afterwards rewarmed in the mains, such as to use the illustration quoted in the paper of a gas passing through a pipe under a bridge and afterwards re-entering the warm ground—it would lose more in candle power in arriving at the testing station than another gas not having been exposed to the same fall in temperature which might occur during consecutive days in the same plant, where on the second day the outside temperature would not chill the gas in passing under the bridge below the temperature of the ground, the atmospheric temperature having warmed up in the meantime. The hygrometer is the only apparatus that will permit of such a determination being made readily, quickly and accurately. The usefulness of the instrument can be illustrated by citing the following case:

In Philadelphia the city inspector reads the candle power at a testing station 1 mile from each of the works. At testing station "B" the 30-inch gas main, from which the service leading to the testing station is taken, runs on the opposite side of the street from the station. Several years after the service was laid the Water Department, in running a 20-inch water main on the near side of the street to the testing station, that is, between our 30-inch gas main and the testing station, they found it necessary to raise this service pipe to get their main under it. They raised it until it lay just under the Belgian block paving, and this point being much nearer the surface of the ground than any other point in the service or in the 30-inch gas main, exposed the gas to a chilling effect in the service that was not experienced by the gas in the 30-inch main, and which would not be shown on a thermometer inserted into the service in the basement, because from this high point the service again dipped deeper into the warmer ground and did not show any loss in temperature, yet the chilling of this gas, due to this high point, reduced the candle power of the gas below what it would have been if it had not been so exposed. Now, the expensive feature was that the gas that flowed through this service was considered as a sample of the gas in the 30-inch main, and in order to reach the required 22.5 candle power for this sample at the testing station it was necessary to increase the candle power of all the gas sent out from that works, amounting, during the winter time, from 18,000 to 20,000 cubic feet per day. The hygrometer detected this fault in the service. It was found that the hygrometer showed a temperature considerably less than the temperature shown on the thermometer placed in the service in the basement. A further test by the hygrometer on the gas issuing directly from the 30-inch main showed the cooling effect between the 30-inch main and the basement. The service was then dug up and the cause of the cooling was exposed. This alone cost the company many thousands of dollars.

To cite another illustration as showing misleading information given by a thermometer, at one of the holder stations the main leading to the station was laid about 45 years ago. Owing to the filling that occurred in the street since then the main is about 14 feet below

the surface of the ground. A thermometer dropped into the main at the inlet to this holder station will not show a variation of more than 3° during any time of the year, while a hygrometer will show a variation of 40° between the highest point of saturation with hydrocarbon vapors in the summer and the lowest point in the winter.

The hygrometer, as described in the paper mentioned, it must be noted, had a defect. It was found difficult to read dewpoints below 33°, particularly if the air that was bubbled through the pentane was obtained from a room of comfortable temperature in which several flames had been burning, such as a photometer room. There was sufficient water vapor in such an atmosphere that, when bubbled through the pentane and cooled to the freezing point, would make a deposit of frosty material on the inside of the bulb, tending to confuse the observer as to the exact dewpoint. If the test were made in a cold atmosphere, where there was not so much water vapor present, this would not be noticed as a disturbing factor.

In the new form of hygrometer, instead of using air from the room, a small stream of the gas itself is forced through the pentane by the main pressure. Of course, this gas, having the same amount of moisture in it as the gas to be tested, will deposit no considerable quantity of water vapor before the dewpoint is reached.

An objection to both the old and the new form hygrometers is that the bubbling of the pentane washes off the black markings of the thermometer scale. When this occurs the thermometer should be taken out and India ink used to reblacken the etched glass markings of the scale. Another feature should be noticed. There appears to be, under some conditions, a lack of agreement between a hygrometer dewpoint and the temperature of the gas coming off from an up coil. This, of course, is due to the entrained vapors in the up coil, because in all such instances the hygrometer has shown a higher dewpoint than the temperature at which the gas emanates from the up coil.

Inasmuch as these divergencies appear to occur (when they do occur) at the lower temperatures, it might be well to use a down coil instead of an up coil when a low temperature is selected at which the gas is to be chilled on its road to the photometer—say 35°.

Several years' experience with the daily operation by a number of observers, with 70° up-coil, has not disclosed any such contradictory readings as is cited above.

There is one condition, however, where it has been found that the hygrometer, in its present form, cannot be used; namely, when the gas of which the dewpoint is to be taken is much warmer than the surrounding atmosphere. This condition was encountered in the winter time when trying to find the cooling effect of the gas passing through an exposed main on a long bridge. This was a pumping main without any services taken off it, and it was found that during severe weather vapor condensed on the outer tube and obscured the reading of the hygrometer.

Another instance occurred when in a certain case it was desired to obtain the dewpoint of the gas at the inlet to a station meter. The temperature of the meter room being quite low, and the temperature of the gas between 80° F. and 90° F., it was found impossible to get the hygrometer reading on account of the condensation of moisture on the outer tube.

Still another illustration was at a plant of one of the steel companies who were endeavoring to get the saturation point of the enriched blast oven gas which had a dewpoint of 110°. One can readily understand that such a gas would be troublesome in the hygrometer, because any atmosphere at a temperature below 110° would surely cause condensation to form on the outer tube. This shows that the hygrometer, in its present form, must be used in a room at a temperature higher than the dewpoint of the gas to be examined.

Question No. 35.—"What specifications should be inserted in a long term contract for gas oil?"

ANSWER BY THE BUREAU OF INFORMATION.

What is known as gas oil is that product of oil refining that remains after the naphthas, herosene and lubricating oils have been removed; and since the work of the refiner is concentrated on getting the greatest quantity of these more valuable products from his crude material, a gas oil may be considered somewhat in the light of a by-product. It is evident, therefore, that since the refiner cannot control the nature of the crude material that comes from the ground, we must expect considerable variation in gas oils from different territories if not from the same refinery using the same crude oil.

Specifications, to be of value, must narrow down the limits of the quality of the oil furnished thereunder, and unfortunately the grades of oil from different territories are of such diverse natures that it would appear impossible to conform to a useful set of specifications that would not involve great complication and probable inability to prove conclusively serious infractions of the specifications. It would, perhaps, be wiser to ask for tenders of oil with samples of the oil that each bidder proposes to furnish. These samples should be sent to competent consulting engineers who would advise the company as to their relative values. Having then determined upon the field from which the oil was to come, specifications as to the gravity and homogeneity could be drawn up that would safeguard the company against inferior material and would make the detection of this inferior material by test not so laborious as to render the use of the test impracticable.

Items of Interest

FROM VARIOUS LOCALITIES.

ACCORDING to prior announcement all the properties (real and personal) of the Citizens Gas Company, of Independence, Kas., were sold at public auction, by Mr. J. P. Rossiter, under order of the court, the latter part of last month. The purchaser was Mr. Royal S. Litchfield, President First National Bank, of Independence, at his bid of $40,005, cash.

THE Southern Public Service Corporation was organized in Norfolk, some days ago, its objects being the construction of gas and water works. Its tentative capital is $100,000, and its officers are: President, W. H. Fritchman; Vice-President, P. S. Stephenson; Secretary and Treasurer, E. F. Kitson.

A QUEER petition is that recently presented against the Dallas (Tex.) Gas Company by a feminine customer to the local gas commission asking that the Company be required to give her the customary reduction of 10 cents per 1,000 cubic feet. She contends that in fact, if the prompt payment rebate is legal and sound, she is entitled to a greater rebate than the 10-day consumer, since she pays in advance, through the agency of a prepayment meter.

"L. B. S." writing from St. Augustine, Fla., under date of the 30th ult., says: "After a lengthy consideration of the matter of our street lighting system in this city, the authorities have determined to employ both gas and electricity in lighting our streets hereafter, and so the deadlock which appeared possible between the faction's insisting on all gas or all electricity has been sidetracked. The Gas Company's Manager, Mr. George Old, voluntarily asked permission to decrease the number of boulevard Welsbach lights asked for in its specification (150) to 125 lamps, so that arc electric lamps could be provided for the business section of the city. Mayor Masters signed the contract eventually on the split basis named. The Council also took final action in the matter when a Committee (consisting of Aldermen Usina, Corbett and Meiten) was named to locate the boulevard lights which will take the place of the incandescent lights, and also to confer with the St. Johns Light and Power Company to make arrangements for the arc lights which will be used in the public parks, etc. The Welsbach lamps will be placed almost exclusively in the residential portion of the city. This disposition it is believed will give to St. Augustine an up-to-date and thoroughly satisfactory street lighting service."

THE proprietors of the Worcester (Mass.) Gas Light Company have announced that all gas sold in that city after January 1st, shall be billed at the rate of 80 cents per 1,000 cubic feet, a concession of 5 cents per 1,000.

ADVICES from Chester, Pa., under date of the 1st inst., are to the effect that the coke oven plant in Chester, which has been shut down since 1904, will be started in actual working, on or before the 1st prox.

MR. GEORGE H. TAYLER, who has been the dominating factor in the affairs of the Warren (O.) Gas Light Company since 1888, has retired from its service, and from active business generally. The Company has been purchased by several local capitalists, prominent amongst whom are Messrs. C. D. Hoover, S. D. Morgan and E. E. Nash. The ownership in the Warren enterprise changed hands last month, and in the reorganization the following officers were elected: President, O. D. Morgan; Vice-President, E. E. Nash; Secretary and Treasurer, C. R. Seigfried. The plant will be managed by Mr. George Daugherty.

IT is likely that Sierra Madre (Cal.) will soon have gas. The question is merely how best the supply may be laid on. It could be piped from either Monrovia or Pasadena.

THE Consumers Gas Company, of Reading, Pa., maintains 823 lamps in connection with the street lighting of that city.

THE matter of granting a franchise to the projectors of the Southside Gas Company, which is really in Tempe, and which would be more or less of an opposition concern to the existing Pacific Gas and Electric Company, of Phoenix, Arizona, was submitted to the voters on September 26th. The opposition won, the vote having been 47 for to 50 against.

MR. JOHN F. CONNELLY, for many years in a responsible position with the Scranton (Pa.) Gas and Water Company, has resigned from its service in order to engage in the real estate business in Seattle, Wash.

"E. C. W.," writing under date of the 5th inst., incloses the following: "In the case of the State of Minnesota *ex rel.* Latshaw *vs.* Board of Water and Light Commissioners of the city of Duluth, *et al*, recently decided by the Supreme Court, it appeared that the respondents charged a net cash rate of 75 cents per 1,000 cubic feet for gas furnished when payment was made within a specified date, and 90 cents per 1,000 feet when payment was made afterwards. The relator neglected to pay on that date, but subsequently tendered the amount he owed calculated at 75 cents per 1,000 cubic feet. He afterwards tendered a reasonable advance deposit for payment for gas he applied to be furnished with. The respondent refused to accept the deposit until the arrearages were paid, calculated at 90 cents per 1,000 cubic feet, and charge for shutting off and turning on the gas. The relator sought by mandamus to compel the Board to accept his deposit. The court held that under the city charter the respondent was authorized to adopt a rule to the effect that gas would not be supplied to a delinquent person until that person's arrears for gas furnished had been paid; that the regulation in controversy was valid, and that the respondent was justified in including in relator's arrearages the gross price of gas, which was found to be reasonable, and incidental charges for making and severing connections."

MR. A. FYFE HALL, formerly local Manager of the Southbridge (Mass.) Gas and Electric Company for a period of 12 years, has been appointed General Superintendent of the Charlestown (Mass.) Gas and Electric Company.

THE proprietors of the Greenfield (Mass.) Gas Light Company have filed a petition with the Massachusetts Board of Gas and Electric Light Commissioners praying for an approval of an issue of new preferred stock, amounting in par $25, to $20,000.

JUDGE WADDELL, of the Federal District Court, has issued an order directing the sale at public auction of the plant and franchises of the Suffolk (Va.) Gas Company, at the instance of a petition submitted by the Columbia Trust Company, of Philadelphia. Petitioner represents $125,000 first mortgage bonds and all the outstanding certificates of indebtedness issued by the receiver.

"MCGREGOR again sits," so writes "L. T. G.," from Providence, R. I., "for his Company, which for brevity's sake may be called the Pawtucket Gas and Electric Company, has to all intent and purpose closed a contract for the public lighting that is to stand for 10 years—that is, the public lighting in as far as electric lamps are concerned. On an all-night lighting table the rate is to be $105 per arc per annum, and on the 1 A.M., circuit, the figure is to be $70 per lamp. At present Pawtucket maintains a total of 525 electric arcs on street lighting account."

"EVANS," writing from Minneapolis, Minn., under date of the 7th inst., says: "The other morning, while looking over a copy of the *Journal* of this city, I noticed the statement that a Mr. R. K. Tyra, Secretary and Treasurer of the Northwestern Roofing, Cornice and Stamping Works, was the public representative of Minneapolis capitalists who are reported to be about to organize the 'Peoples Gas Light and Fuel Company, who propose to sell gas at 80 cents per 1,000 cubic feet.' It is not stated who the private representative is, but it is fair to presume that this concealment is due to a desire to protect him or her from the public gaze, in that said representative may have to, at one time or another, act as a go between. The account or narrative then proceeds to remark that Mr. Tyra (how near to tyro) declares the Company is only in 'a formative state, as it is neither organized, nor has a figure been put upon the amount of capitalization that the Peoples is to carry.' Some hope, however, is held out in the declaration that 'sites for the plant are being inspected by experts'—which should be balm to Prof. Bemis, in that this might afford him a golden or silvered opportunity for the exercise of his peculiar talents. A calm survey of the situation at Minneapolis in this respect I think fairly goes to show that the existing Company will not be greatly embarassed by its tentative rival for much time to come. Before taking final leave of the subject I think Mr. Tyra tells the truth plainly in the closing sentence, in which he remarks that 'Outside financial help will be small.'"

THE proprietors of the Sioux City (Ia.) Gas and Electric Company have appealed to the authorities to submit to the vote of the residents, at a special election, to be held November 17, an ordinance repealing the third section of the ordinance under which the Company operates. That ordinance contains what is generally known as the purchase clause, and provides, in substance, that the city shall have the right to purchase the property of the Company at the expiration of 10, 15, 20 or 25 years, by paying the appraised value thereof, on the basis of the cost of duplicating the plant at the time." This clause has made it very difficult for the Company to go into the bond market and purchase money on any sort of satisfactory terms.

MESSRS. RATHBONE, SARD & CO., of Albany, N. Y., inform us that, since the first inst., Mr. John J. Garrison has been associated with their Company as Sales' Manager of the gas stove department.

SUPERINTENDENT FERGUSON, of the Portsmouth (Va.) Gas Company, has assured the residents of the Port Norfolk and Pinners' Point districts that if a thorough canvas, now being made, of these places show a number of prospective gas users sufficient to justify the main extensions necessary, such extensions will be made forthwith.

THE National City Bank, of New York, has notified the holders of the 6 per cent. convertible debentures issued by the Consolidated Gas Company will now be received for conversion into stock, the transfers to be made at the Bank's headquarters, 52 Wall street.

R. G. STEVENS, writing from Milwaukee, Wis., under date of October 5th, forwards the following: "City Attorney Burgess has received notice from the Wisconsin State Railway Commission that there will be a hearing on the 28th inst., at 9 A.M., Madison, Wis., in the office of the Commission in the State Capitol Building, with reference to rates charged by the Racine Gas Light Company. In the complaint, the full text of which was printed in the regularly selected advertising channels, it is alleged that the rates charged by the Racine Gas Light Company for lighting and fuel are too high; that meters do not accurately measure gas charged for fuel and lighting gas. Rates charged in other cities were quoted, tending to show that these were higher than those charged in the other city. Immediately after the complaint was filed with the State Railway Commission experts were sent here to make a valuation of the Company's plant, and to determine other facts in regard to the Company's ways and methods."

THE absorption of the Big Rapids (Mich.) Gas Company by the Grand Rapids Gas Company has been completed. The property will be directly in charge of Mr. O. T. Calkins as General Manager.

THE new owners of the Warren (O.) Gas Light Company have announced the following reductions in the selling rates: 1,000 to 20,000 cubic feet per month, 95 cents per 1,000; to meters of the prepayment type, 90 cents per 1,000.

"THE Pacific Light and Power Company, of Los Angeles, Cal., in accordance with the agreement heretofore published in your columns, took over the property of the City Gas Company, October 1st. This looks the taking of the first aggressive step towards the proposed goal of uniting all the local gas and electric lighting interests in one great property. Mr. C. A. Balch, General Manager of the Pacific Light and Power Company, takes general charge of affairs, replacing Mr. Alexander Ross, who retires. By-the-way, a very great many of us sorely regret this fact, for he surely made himself liked in high degree. Mr. Joseph M. Berkley retains his position as Chief Engineer to the new concern, which is known as The Domestic Gas Company.—M."

ACTING under the authority granted them at the last annual meeting of the shareholders, the Directors of the Denver Gas and Electric Company some days ago adopted a plan to create a sinking fund to retire the bonds of the Company when and as they become payable. Under the scheme between $70,000 and $80,000 of them will be called May 1, 1910, and redeemed at 102, and each year thereafter a certain allotment of the bonds will be called in. Those called in 1911 will be redeemed at 103, those of 1912 at 104 and those of 1913 at 105, interest in each case being added. The redemption will be by lot. The authorized issue is $8,000,000, of which $7,230,000 were issued. The plan for the retirement of the bonds will not in any way affect the dividend returns now received by stockholders. Unless unforseen losses occur they will receive their annual 6 per cent., inasmuch as the Company is now earning about 2½ times the interest on its bonded debt. The Directors also provided for the issue of bonds of small denominations, ranging from $100 to $500 and exchangeable for the regular $1,000 denomination at the option of the investor. This is for the accommodation of people of small means who may desire to invest their savings in the Company's securities.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, OCTOBER 12, 1908.

The Market for Gas Securities.

The depression in the general share market is altogether responsible for the rather sharp decline experienced in gas share quotations for the past week. It is noteworthy also that the transactions in Consolidated were virtually all for cash. It opened this morning at 143 to 143¼. It is cheap at these figures. City gas bonds are rapidly increasing in quoted values.

Brooklyn Union is fairly steady, and the same may be said of the balance of the list, despite the uneasiness in monetary circles over what is said to be the imminence of war on Asiatic borders. We note a sale at 98 of Detroit City fives, and of Hudson County (N. J.) fives at 103. Underlying Consolidated bonds seem to afford great opportunities for sensible investment.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

OCTOBER 12.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$73,177,000	100	143	143½
Central Union Gas Co.—				
1st 5's, due 1928, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	130	160
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	102
New York & Richmond Gas				
Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	98	104
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	100	105
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	86	91
Standard	5,000,000	100	70	100
Preferred	5,000,000	100	100	125
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	134	144
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91½	92
Yonkers	200,000	500	130	—
Out-of-Town Companies.				
Bay State	50,000,000	50	2	2½
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	63	66
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,660,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	20,500,000	100	91¾	92
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	92	98
Columbus (O.) Gas Lt. & Heating Co.	1,682,750	100	90¼	91
Preferred	3,026,500	100	71	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,000,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	—	—	74½	75
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100¼
Detroit Gas Co., 5's	881,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113¼
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	200,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	96
Bonds, 1st 5's	3,832,000	1,000	102	104
Laclede Gas Co., St. Louis.	10,000,000	100	—	100
Preferred	2,500,000	100	60	90
Bonds	10,000,000	1,000	104	104½
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,870,000	50	143	145
Madison Gas and Electric Co.	—			
" 1st Mtg. 6's	350,000	1,000	106	106¾
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	55	56½
Preferred	25,000,000	100	88	89½
Montreal Gas Co., Canada	9,000,000	100	218	218¾
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	94¾	95
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104¾	105¾
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	92	—
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	2,465,000	1,000	96¾	—
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	102	—
Washington (D. C.) Gas Co.	2,600,000	20	327½	330
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas Co.	600,000	50	220	—

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OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Sept. 9, 1908.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable Oct. 15th, 1908, to stockholders of record at the close of business, Sept. 30, 1908. Checks will be mailed.

1736-5 LEWIS LILLIE, Treasurer.

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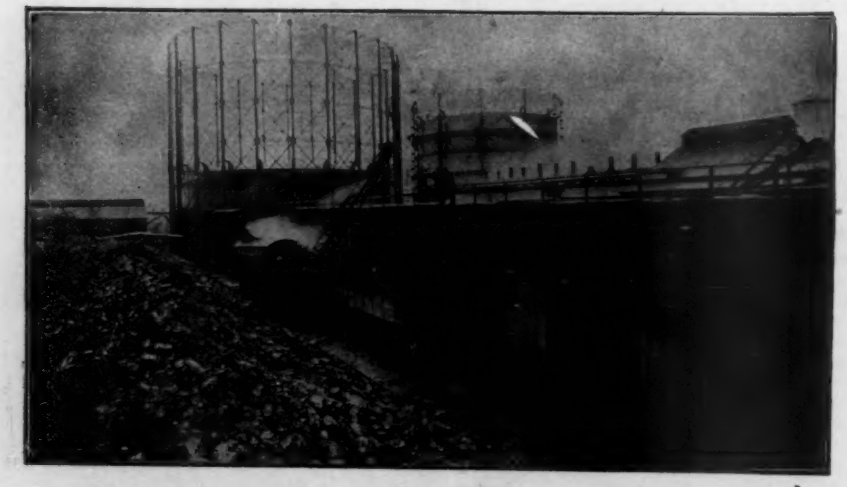

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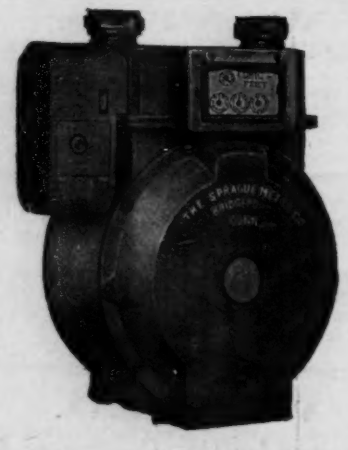

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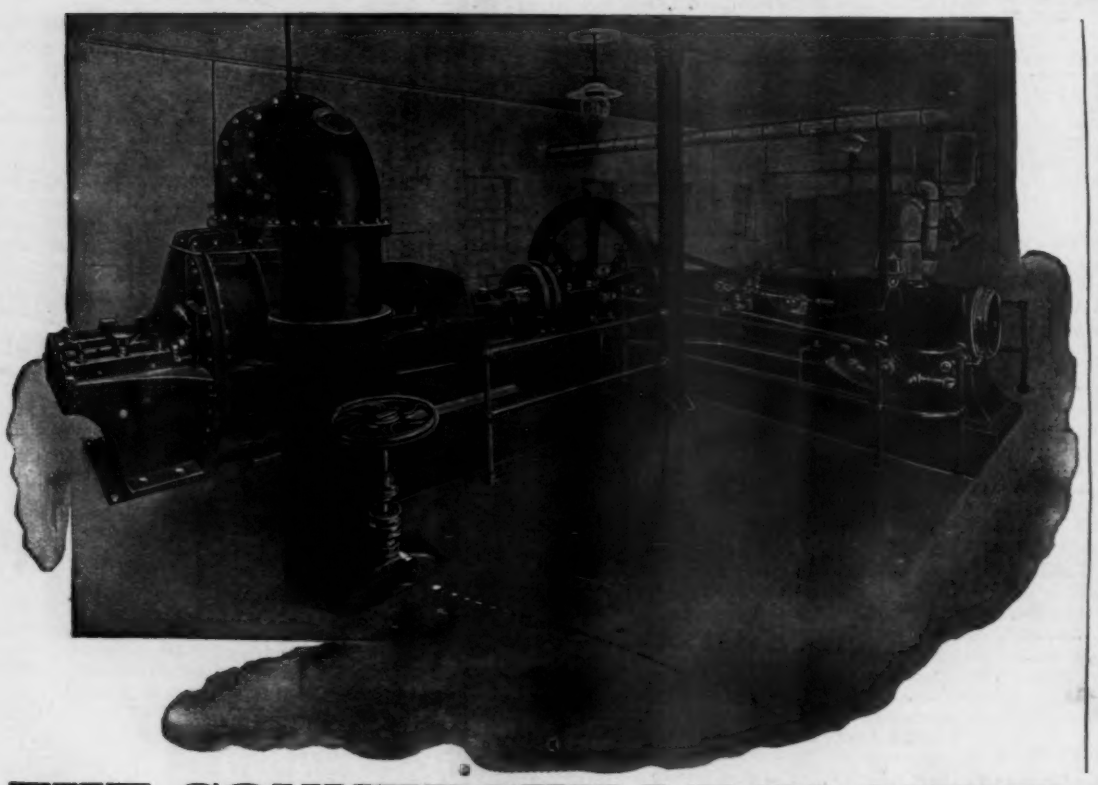

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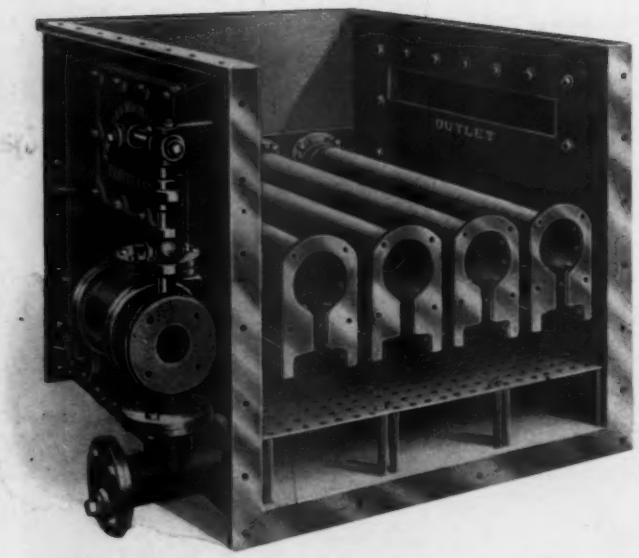

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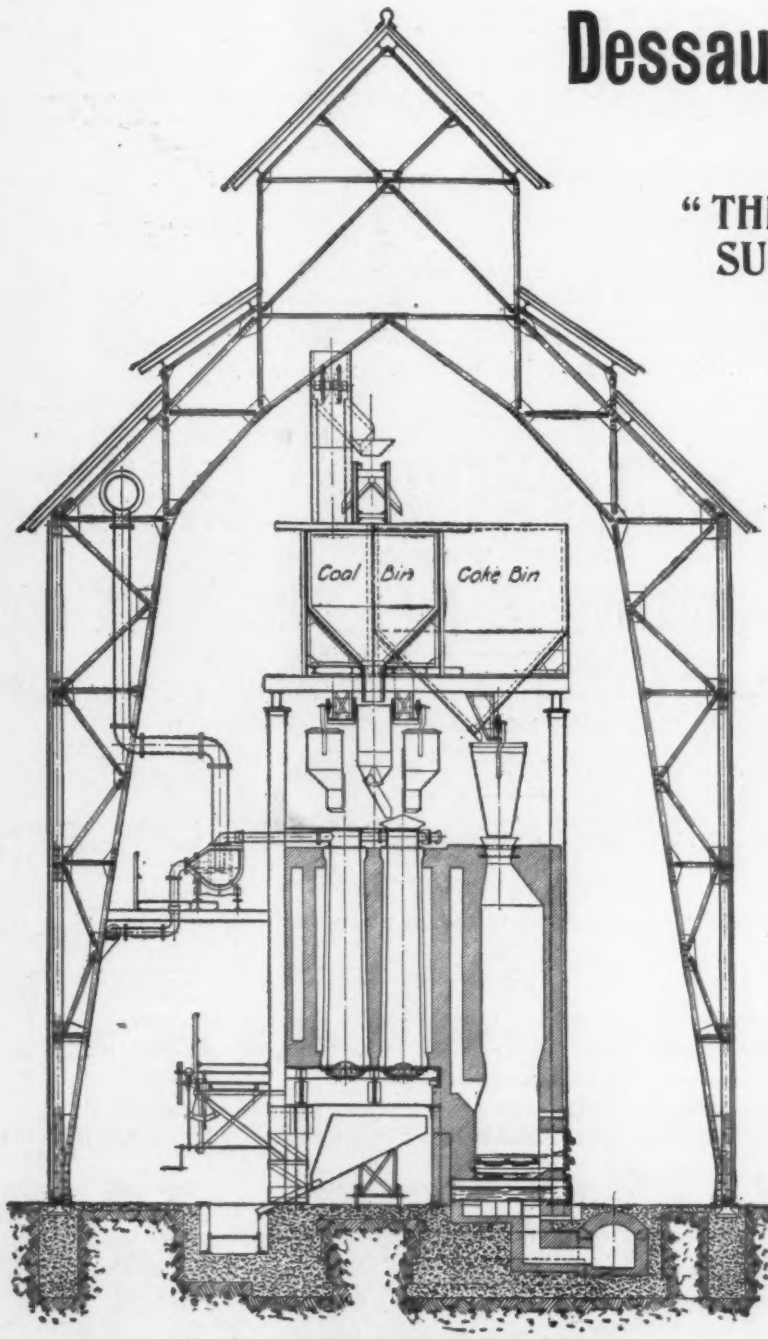

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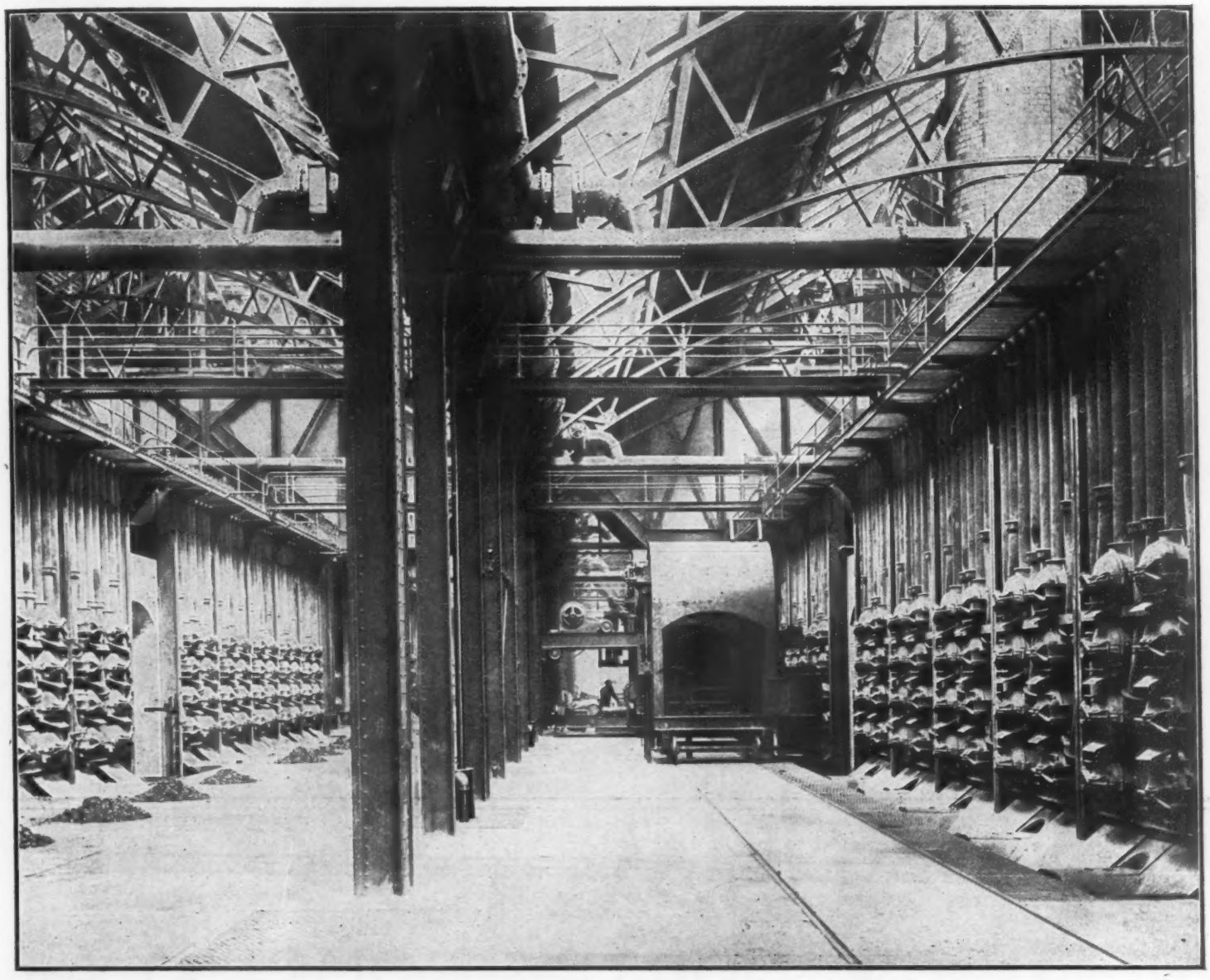

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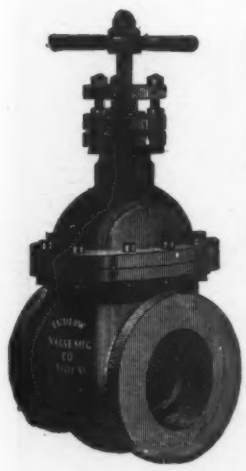

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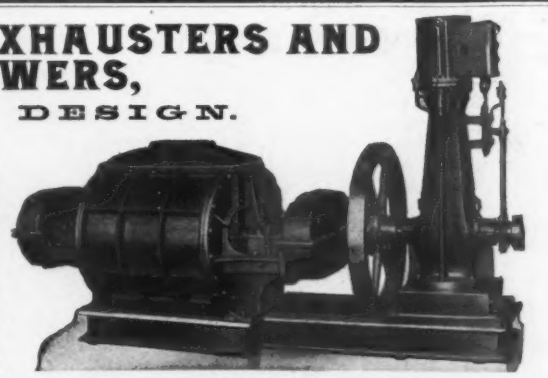

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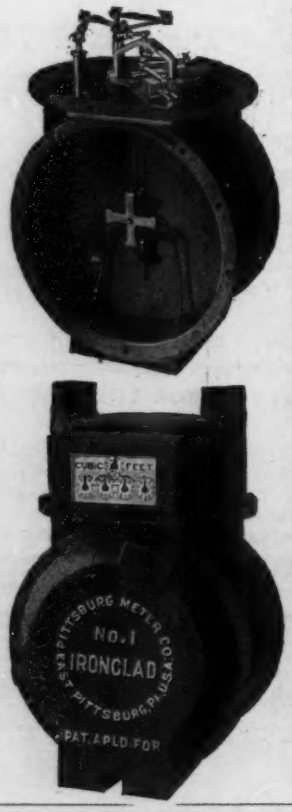

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are cast in one piece, and attached to the main case, assuring absolute and permanent alignment of valve seats and valves and positive and accurate operation.

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GAS APPARATUS.

DETROIT - MICHIGAN

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Humphrey Instantaneous Bath Water Heaters

Should be used in every home. They make Hot Water **always** ready. Require no attention after installation. Hot water pours forth at any time upon lighting the gas. Close off the gas and all expense ceases. **Absolutely Guaranteed.**

Special Merits.

A burner that won't light back; a rust proof enameled shelf; a removable base plate for ready access to burner.

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No. 19 Mueller Drilling Machine.

(Patent Applied for.)

There is neither advantage nor economy in using a big drilling machine for a class of work for which a small machine is made.

The No. 19 Mueller Drilling Machine is especially designed for drilling $\frac{1}{8}$ to $\frac{1}{2}$-inch holes in high pressure gas mains under pressure or water mains under pressure.

In drilling gas mains a service clamp and high pressure gas main cock or other fitting is used.

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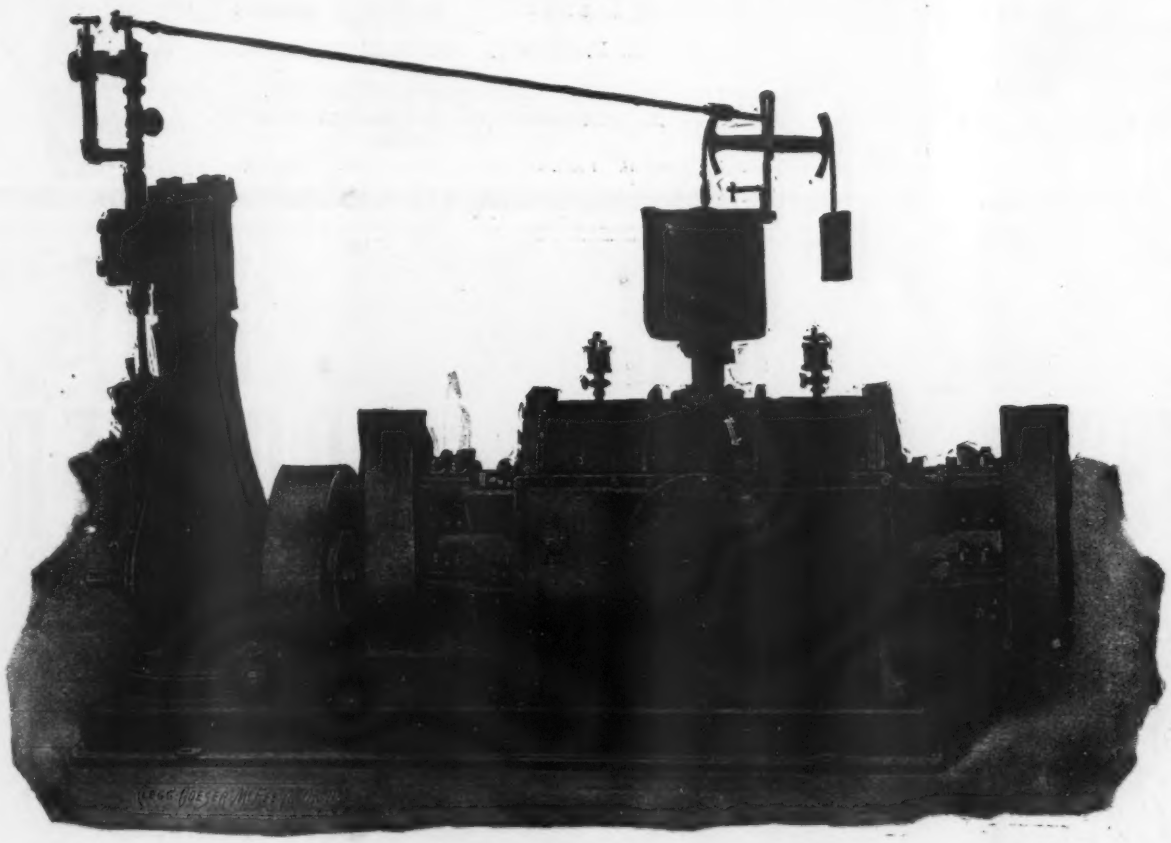

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PATENT SMOKED CHART RECORDERS.

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Operates
Under All Pressures
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25-Candle Power
Per Cubic Foot.

Bray's
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Can be Used
On Ordinary or Special
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Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

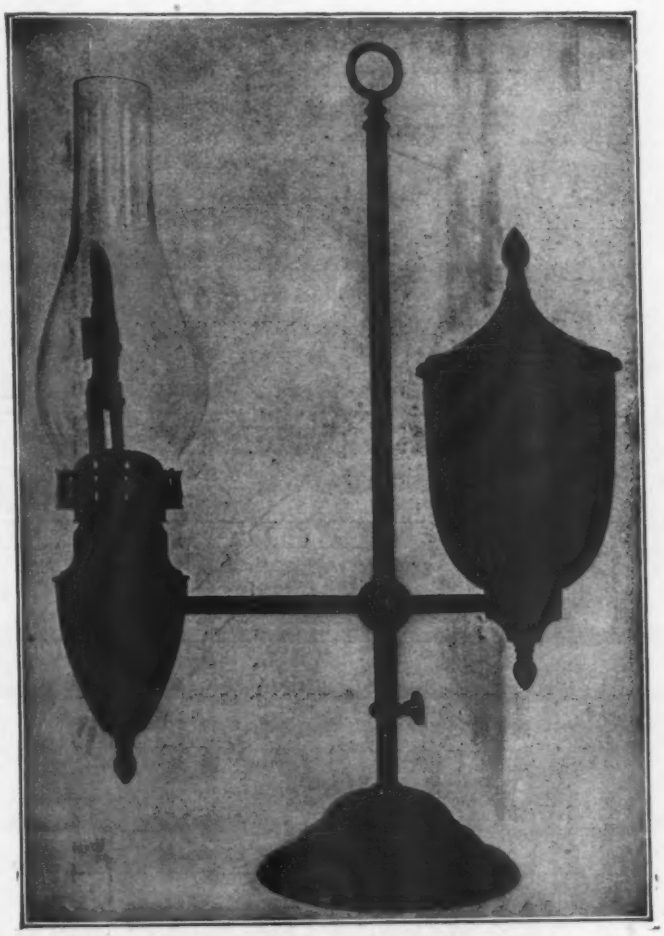
NOVEMBER, 1908.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Sun.	1	10.30 PM FQ	5.30 AM
Mon.	2	11.40	5.30
Tue.	3	12.50AM	5.30
Wed.	4	2.10	5.30
Thu.	5	3.20	5.30
Fri.	6	No L.	No L.
Sat.	7	No L FM	No L.
Sun.	8	No L.	No L.
Mon.	9	5.20PM	7.00PM
Tue.	10	5.20	7.40
Wed.	11	5.20	8.30
Thu.	12	5.20	9.20
Fri.	13	5.20	10.20
Sat.	14	5.20	11.20
Sun.	15	5.10LQ	12.20AM
Mon.	16	5.10	1.10
Tue.	17	5.10	2.10
Wed.	18	5.10	3.10
Thu.	19	5.10	4.10
Fri.	20	5.10	5.50
Sat.	21	5.10	5.50
Sun.	22	5.10	6.00
Mon.	23	5.10NM	6.00
Tue.	24	5.10	6.00
Wed.	25	5.10	6.00
Thu.	26	5.10	6.00
Fri.	27	5.10	6.00
Sat.	28	8.20	6.00
Sun.	29	9.30	6.00
Mon.	30	10.40FQ	6.00

TOTAL HOURS DURING 1908.

By Table No. 1.

	Hrs.Min.
January	228.30
February	187.30
March	192.00
April	160.10
May	155.10
June	138.00
July	155.50
August	173.40
September	185.20
October	214.00
November	218.10
December	226.40
Total, yr.	2235.00



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10-Candle Power.

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This lamp is a perfect substitute for the 10-candle Pentane Lamp hitherto used, and has the following advantages:

1st. It uses Standard Kerosene Oil (Pratt's Astral Oil or equivalent).

2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

NOVEMBER, 1908.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Complete Lighting in One Hour	Complete Extinguishing in 50 Minutes
		From Time Given	
		P. M.	A. M.
Sun.	1	4.37	5.17
Mon.	2	4.37	5.17
Tue.	3	4.37	5.17
Wed.	4	4.37	5.17
Thu.	5	4.27	5.27
Fri.	6	4.27	5.27
Sat.	7	4.27	5.27
Sun.	8	4.27	5.27
Mon.	9	4.27	5.27
Tue.	10	4.27	5.27
Wed.	11	4.27	5.27
Thu.	12	4.17	5.32
Fri.	13	4.17	5.32
Sat.	14	4.17	5.32
Sun.	15	4.17	5.32
Mon.	16	4.17	5.32
Tue.	17	4.17	5.32
Wed.	18	4.17	5.32
Thu.	19	4.12	5.42
Fri.	20	4.12	5.42
Sat.	21	4.12	5.42
Sun.	22	4.12	5.42
Mon.	23	4.12	5.42
Tue.	24	4.12	5.42
Wed.	25	4.12	5.42
Thu.	26	4.07	5.52
Fri.	27	4.07	5.52
Sat.	28	4.07	5.52
Sun.	29	4.07	5.52
Mon.	30	4.07	5.52

TOTAL HOURS DURING 1908.

	Hrs.Min.
January	481.50
February	329.15
March	351.50
April	341.50
May	233.05
June	218.10
July	282.55
August	254.55
September	292.25
October	420.45
November	374.30
December	411.05
	3992.35
Deduct on account of 50 min. extinguishing time	30.30
Total, yr.	3962.05

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....OF AMERICA....

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By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

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It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

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For decorative appearance and large volume of light at a popular price to the consumer,

THE CHIC LIGHT

is practically alone in the field. Complete satisfaction to the user is its strong point.

THE CHIC LIGHT—Design No. 71310.

PRICES:

Boxed complete, with No. 71 Welsbach burner, No. 310 F. Q. M. cylinder, No. 196 Junior J Brand Welsbach mantle, including the No. 316 opal shade, which will be packed separately.

Price, complete, clear cylinder, each, dozen lots, ... $1.35
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When supplied with **No. 310 F. Q. M. Opal Cylinder** add 10 cents to above list.

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Package Contains 16 Dozen.

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Everett, Mass.
Jenkintown, Pa. (2d contract).
Coney Island, N. Y.
Mexico, Mo.
Jacksonville, Fla.
Syracuse, N. Y. (2d contract).
Atlanta, Ga. (2d contract).
Holyoke, Mass.
Peoria, Ills.
Schenectady, N. Y. (2d contract).
Danbury, Conn.
Galveston, Tex. (2d contract).
Quebec, Canada.
Indianapolis, Ind. (2d contract).
Bessemer, Ala.
Waterbury, Conn. (5th contract).
Sioux Falls, S. D. (3d contract).
Philadelphia, Pa.
New Hartford, Conn.
Poughkeepsie, N.Y. (2d contract).
Nashville, Tenn.
Salisbury, Md.
Norfolk, Va. (4th contract).
Wallingford, Conn.
Richmond, Va. (2d contract).
Oak Bluffs, Mass.
Arlington, Mass.

TOTAL SETS INSTALLED DURING YEAR, ... 43
TOTAL SETS INSTALLED TO DECEMBER 31, 1907, ... 677
TOTAL DAILY CAPACITY, TO DECEMBER 31, 1907, ... 545,865,000 cu. ft.

Tar Extractors for Carburetted Water Gas.
Photometrical Apparatus.
Gas Analysis Apparatus.
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Straight Standpipe System for Coal Gas Retorts.
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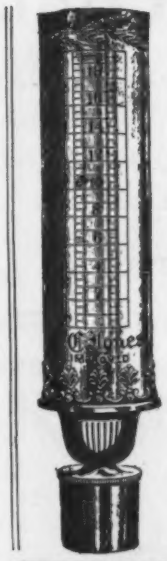

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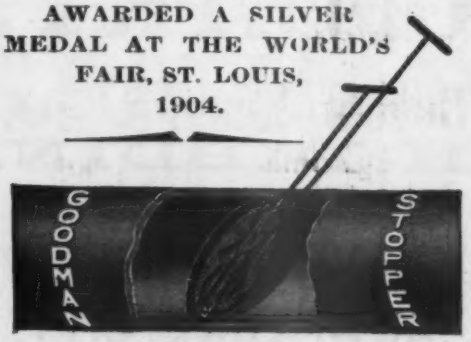

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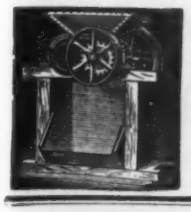

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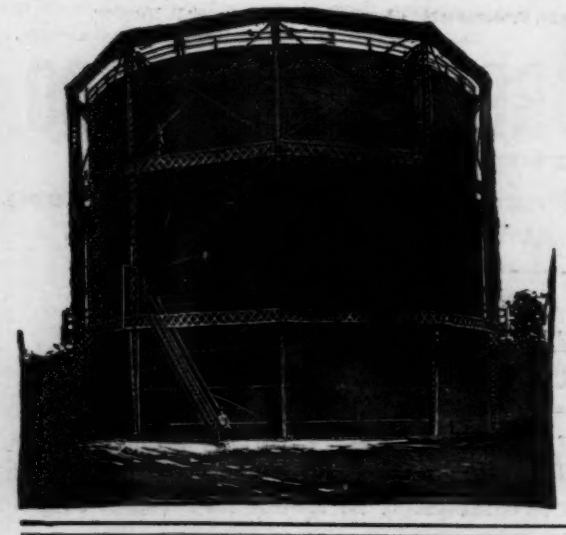

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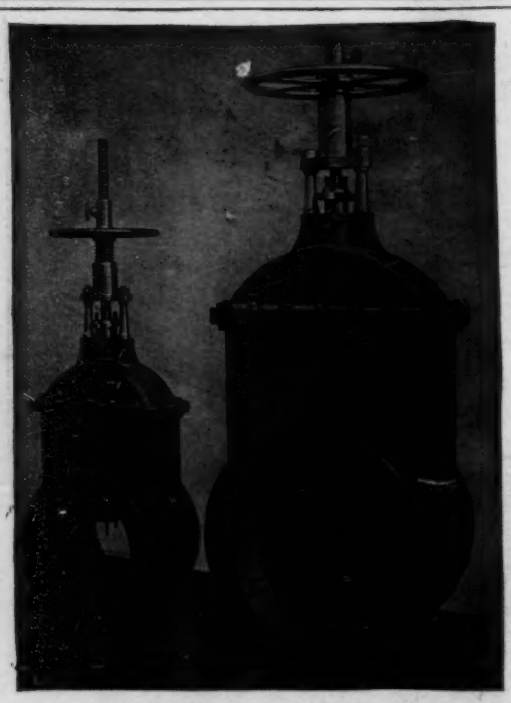

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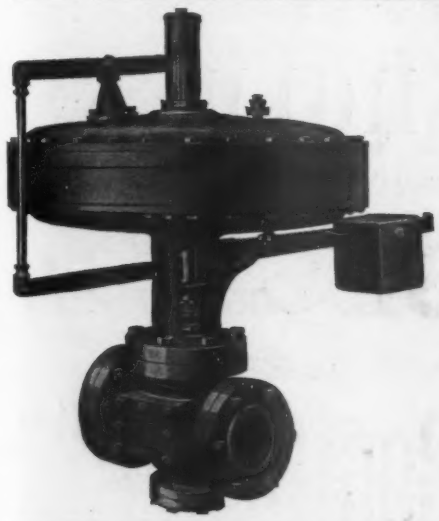

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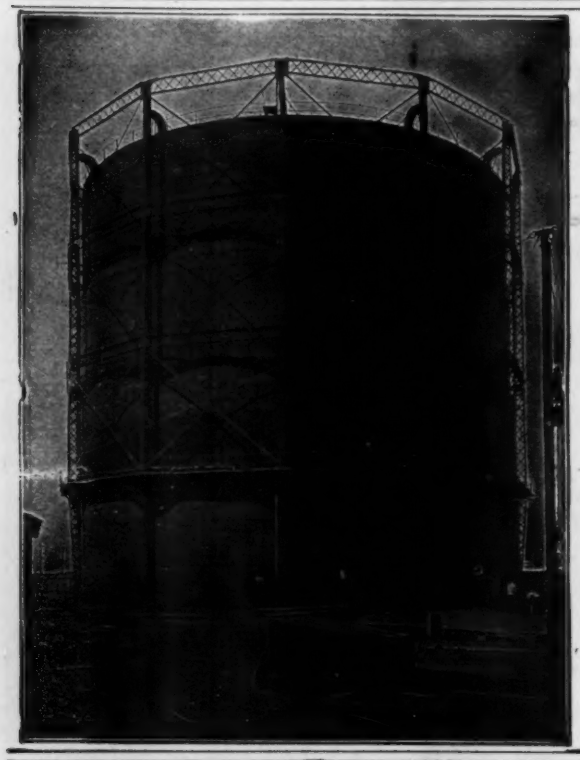

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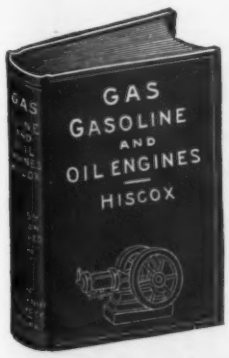

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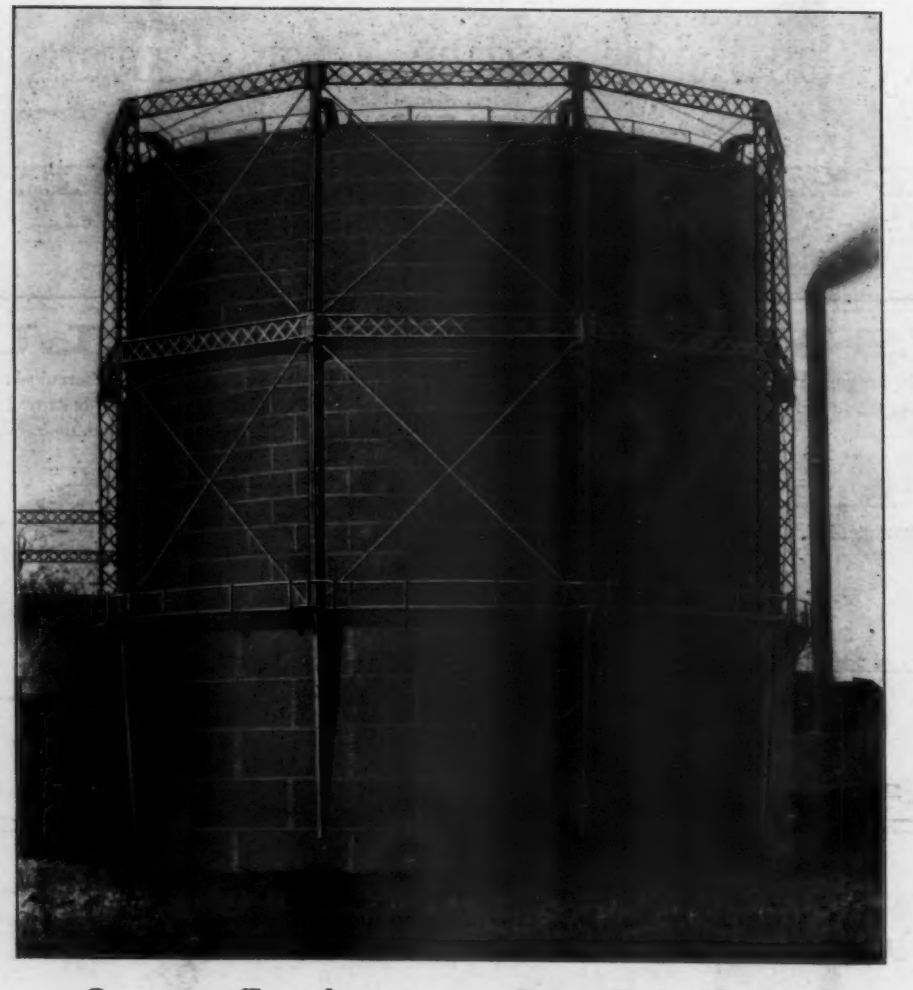

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